THE

ELECTRICAL REVIEW.

VOL. LX. FEBRUARY 22, 1907. No. 1,526.

ELECTRICAL REVIEW.

Vol. LX.] CONTENTS: February 22, 1907. [No. 1,526.

	Page
An Electric Supply Company's Finance...	289
A L.C.C. Tramway Valuation Move	290
Conduit Tramways and Snow Troubles	290
Supply of Electricity within a Borough	290
What is a Complete Installation?	291
The Christchurch Electric Supply Station, N.Z. (*illus.*) ...	291
Legal	292
Correspondence:—	
The Cramp Neutralised Repulsion Motor	297
Jerry Wiring.—Technical Literature	298
Electric Clock Installations	298
Wireless Telegraphy and the Admiralty Agreement ...	298
Rail Corrugation	299
Metallic Filament Lamps.—Shift Engineers	299
Electrical Development Association	300
Dignity in Debate	300
Mica Insulator Co., Ltd., *v.* Geo. Schultz & Co.	300
Parliamentary	300
New Electrical Devices, Fittings, and Plant (*illus.*)	302
Business Notes	303
Notes	310
City Notes	313
Market Quotations	318
Stocks and Shares	318
Share List of Electrical Companies	319
Exports and Imports of Electrical Goods during Jan., 1907	321
Proceedings of Institutions:—	
Investigations on Light Standards and the Present Condition of the High-Voltage Glow Lamp (*illus.*) ...	322
Suction Gas Engines and Gas Plants	324
Cost of Living in South Africa	326
Notes on Turbine Troubles	327
Wireless Telephony (*illus.*) (*continued*)	327
Commercial Development of Electricity Supply (*illus.*) ...	329
Legal Query Column	330
Separate Generating Stations	331
New Patents Applied For	332
Published Specifications	332

READY!

THE

UNIVERSAL ELECTRICAL DIRECTORY

(J. A. BERLY'S).

1907 EDITION.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEKKAY, LONDON." Code, A B C.

Telephone No. 933 Holborn; 4425 Central.

All Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades.

AND HAS

BY FAR THE LARGEST CIRCULATION

of any Electrical Industrial Paper in Great Britain.

SUBSCRIPTION RATES.—In Great Britain, Post Free, per Year, 19s. 6d. To all other countries, per Year, £1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each; post free 2s. 9d.

READING CASES, to hold from One to Twenty-six Numbers until the volume is complete for Binding, can be had from the Publishers, Price 6s., or Free by Post (in Great Britain), 6s. 6d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. Paris: VEUVE J. BOYVEAU, 22, Rue de la Banque. Berlin: ASHER & Co., 13, Unter den Linden.

Cheques and Postal Orders (on Chief Office, London), to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

AN ELECTRIC SUPPLY COMPANY'S FINANCE.

IN one of the smallest meeting rooms at Winchester House on Friday last a handful of shareholders were engaged in resisting the proposal of the directors of the Smithfield Markets Electric Supply Co., Ltd., that the dividend on the ordinary shares should be passed. Considered on the same basis as in previous years, sufficient profit had been earned to admit of the payment of a fair dividend, but the directors appear now to have awakened to the fact that the agreement with the City Corporation expires in 1913, and apparently very faint hopes are felt that a renewal will be obtained. The Corporation has, as the result of negotiations last year, informed the directors that the application for a renewal of the contract is premature. There has been no refusal, but, presumably, the Corporation feels that important events may occur in connection with electricity supply during, say, the next five or six years, which render it undesirable to fix up engagements for a long term ahead. On some grounds this is a not unintelligible attitude, but, from the company's point of view, it is a matter of considerable seriousness. It being uncertain whether a renewal would or would not be obtained in 1913, the auditor, acting in the interests of all classes of holders in the company, and not necessarily being unduly swayed by regard for the debenture-holders' interests—as some appeared inclined to think—drew attention to the necessity for conserving the capital of the company, so as to be prepared in the event of the worst happening.

The figure at which the capital assets appear in the balance-sheet is admittedly very high, bearing in mind the conditions under which the concern has been working, and shareholders have necessarily to accept risks if they put their money down on the strength of so unstable a security as the changing policies of corporations. A few small dividends they have received, but the question has now arisen whether it is not better for them to apply their revenue to promoting the financial soundness of the company in the hope of getting back whatever they have put into it in the shape of capital, in that eventuality which the directors, at least, appear to contemplate. The shareholders present voted *en bloc* against the adoption of the report, and after much argument the meeting had to be adjourned for a month, with the understanding that the directors are to meet a deputation from the shareholders in the interim to discuss the position.

The directors are acting under the advice of counsel, but it is doubtful whether the ordinary shareholders will be guided by such opinion. They may feel that it is better for them to be receiving dividends on their capital for the next five or six years, even if they do have to lose their capital value in the long

run; they may prefer to take what they can get while they can get it. They may also indulge the hope that there is still the chance that the capital may remain practically intact in the event of the Corporation renewing the contract for a further term.

But then there is the doubt as to the security of the position of the debenture-holders. They naturally have a first claim to consideration, and as the auditor of the company stated, profits for distribution as ordinary dividend cannot fairly be said to have been earned until proper regard has been paid to the conservation of the capital of the undertaking. We have always argued against local authorities putting to rate reductions what ought to be placed to depreciation and sinking funds. Companies, too, need to pay attention to the same questions. But we need not refer at greater length to the matter at the present juncture. We have given the report of the proceedings in fuller detail than is generally necessary with this small company, because the position that has developed is unique and interesting in connection with electric supply, while it may also be disastrous for those who have put money into its ordinary shares unless the City Corporation can be induced to come speedily to a decision on the point in question, giving due regard to the fact that the company has served its consumers well, and has not yet had an opportunity of giving a reasonable return to those who have put their money into it. We cannot help feeling, however, that unless the directors know more than they say regarding the probable attitude of the Corporation, they have shown an excessive frankness—which would be better described as weakness—in divulging their views of the probabilities of the situation in the manner reported. But we are thoroughly in sympathy with any advocacy for conserving capital interests in electrical undertakings. The pity of it is that with the shortness of tenure of the Smithfield Markets undertaking the position was not grappled with even earlier. The public too often put their money into concerns without paying proper regard to the terms and conditions under which those concerns are working, but sometimes they receive a rude awakening, as has here been the case.

A L.C.C. Tramway Valuation Move.

The predominant party at Spring Gardens has enshrouded in a veil of secrecy a report prepared by the valuer to the County Council respecting the value of the tramway undertaking. It was stated several weeks ago, in the course of a report by the Finance Committee, that the tramways had been valued by the official in question at £7,500,000 as the market price, as compared with an expenditure of about £5,000,000 which has been incurred down to the present time. It appeared that the valuation formed the subject of a confidential report by the valuer, and as no resolution had been considered or passed by the County Council requisitioning the preparation of a report on the question, and as no proposals have been made either for selling or leasing the tramways, it is obvious that the document was called for by either the Finance Committee or the Highways Committee in order to impress upon the public the financial importance of the tramways in connection with the forthcoming elections. Various requests have been made by members of the minority party, for the publication of the secret report in order that information might be obtained as to the basis upon which the valuation, showing a paper surplus value or profit (!), as has been alleged, of £2,500,000, was formed. But the report has only been forthcoming this week, and it has been issued to the members marked "confidential." An attempt was made at Tuesday's meeting to secure the publication of the report, but this was refused on the ground, as was alleged, of the practice of the Council not to publish confidential reports by officials; and for a similar reason the chairman of the Council declined to allow the document to be discussed. If the tramways were in the market either for sale or lease, there would be solid grounds for withholding information as to how the estimated value of the undertaking as a going concern was arrived at, but as neither the one nor the other action is in contemplation, it is easy to understand that the report is intended for electioneering purposes, and that the present predominant party is afraid that the divulgation of the details might be turned to its disadvantage at the impending elections.

Conduit Tramways and Snow Troubles.

The management of the Grand Berlin Tramways Co. has issued a statement in reply to criticisms which have been passed upon the recent breakdowns of the few underground conduit lines in Berlin, and which were accompanied by assertions that the same system in other cities was free from such interruptions during falls of snow. It is stated, however, that similar troubles arose in other cities. In confirmation the management observes that in a report issued by the Brussels Tramway Co. it is mentioned that the troubles during the snowy period were, in the first place, attributable to the underground conductors, and that the working of the lines could not be properly maintained on a repetition of similar events, notwithstanding the existing large reserve plant. The report also showed that the results produced by overloading and short circuits were the same as in Berlin. At Buda-pest the whole of the tramways were completely stopped from December 27th to December 31st inclusive. The underground conduit lines were the first to collapse. The conduit tramways at Vienna, on the other hand, are said to have worked without any failure during the whole of the period of snowfall. In the opinion of the management of the Berlin company, the reason lies in the fact that the conditions for the conduit system are more favourable than in the German capital. The length of the conduit sections at Vienna surpasses by far that of the overhead trolley lines connected with them, and the sensitive ploughs are located in the conduit for the greater portion of the journey, whereas in Berlin the reverse is the case, as the ploughs for the larger portion of the journey are raised and hang under the cars, where they are subject to the influence of the road dirt and salt water, due to the use of salt for melting purposes. In addition to this the management points out that the traffic in the two cities is not comparable. The underground conduit sections in Berlin represent the most important and most heavily loaded lines, and the large amount of ordinary wheeled traffic takes to the tramway track and forces fresh snow into the conduits just after cleaning, but the less amount of vehicular traffic in Vienna, especially as the greater portion of the conduit tramway is situated in the wide Ring Strasse, has by no means the same effect. As an example of Berlin conditions, it is mentioned that 100 men were employed for three days and nights in clearing the conduit in the congested Konig-gratzer Strasse, but in the Charlottenburger Chaussee, Roon Strasse, &c., where the traffic is equivalent to that of Buda-pest, Vienna and Brussels, the time occupied in clearing the conduit was considerably shorter.

Supply of Electricity Within a Borough.

The *Justice of the Peace* recently contained a query and answer which are of interest to local authorities who have power to supply electricity. It appears that some years ago a borough council obtained an electric lighting order to supply electricity within the borough as then constituted, but since obtaining such order the borough has been extended. The

Local Government Board have recently sanctioned the raising of a loan for carrying out an electricity extension, but as the greater part of the extension is to supply electricity in the added part of the borough, the persons advancing the loan have raised the point that under the lighting order the council has no power to go into the extended part of the borough without first obtaining additional statutory powers. Seeing that the loan is to be raised by mortgage upon the rates leviable over the whole borough, the question is one of considerable difficulty.

As a general rule electric lighting orders contain a provision to the effect that "the area of supply shall be the area named for that purpose in the special order." If the area is merely described as "the Borough of West Ham" it would seem that if the boundaries of the borough are subsequently extended by Parliament, the area in which electricity may be supplied is extended at the same time, even if the Legislature never so intended. But where the existing boundaries of the borough were set out on a map or plan, it is apprehended that the undertakers would be limited to that area only, unless the later Act specially referred to the earlier one, and made it clear that the electric lighting area was to be exceeded.

What is a "Complete" Installation?

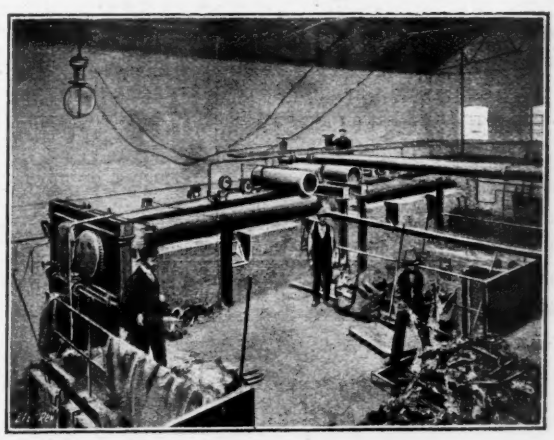
We publish elsewhere in this issue a report of the case of Robert Cort & Sons *v.* Holford, which was decided by the Common Sergeant at the Mayor's Court on February 12th. The main question appears to be of some interest to electrical engineers and contractors. It was: What is meant by a *complete* installation? If a man undertakes to put in a complete installation for the lighting of a private house, what are his obligations? In the case in question the plaintiffs quoted for the electrical part of an installation which was to be used for lighting the defendant's house in Essex. They were suing for the balance of their account. The dynamo, which was to charge accumulators, was to be worked by a 3-H.P. engine, which the defendant had in his possession. The plaintiffs agreed to provide a complete installation for a certain sum, that sum being made up of a number of items, including accumulators, switchboard and other fittings, but apparently not including a cut-out or shunt resistance. The main point in the case was whether a cut-out and a shunt resistance were necessary parts of a complete installation. If so, they could not be charged for as extras. It was contended on the part of the defendant that, given a good 3-H.P. engine, a cut-out and resistance were necessary. The plaintiffs, however, replied that when making their estimate they assumed that the engine was new; that if it had been new, a cut-out would not have been necessary, and that they were, therefore, justified in charging for cut-out and resistance as extras. They also alleged that since the specification was made out the defendant had demanded an increase in the size of the battery. Had they known that the battery was to be larger, this would have influenced their judgment in deciding whether to provide a cut-out. The learned judge decided this point in favour of the defendant, laying it down as a general principle that a cut-out and shunt resistance should always be supplied. He was not, apparently, impressed with the argument that the increase in the size of the battery would have affected the plaintiffs' judgment.

In the event the plaintiffs' claim was reduced by £5, but they recovered the remainder. The principle of this case should be noted by electrical contractors. Even if a specification is carefully prepared, setting out every item, and the contract is to supply a "complete" installation, no charge can be made for omissions from the specification. This principle has long held good in the case of a builder's contract. So where a builder contracted to erect a house complete for a lump sum, and set out the items in plans and a specification, but omitted the flooring, he was not entitled to charge for the flooring as an extra.

THE CHRISTCHURCH ELECTRIC SUPPLY STATION, NEW ZEALAND.

This combined station serves the City of Christchurch and suburbs with a population of 42,000. Owing to the expense in disposing of the house refuse the Council decided on the erection of a combined destructor station, and a loan of £18,000 was raised for this purpose. The station buildings consist of a boiler room and an engine room, surmounted by a tipping floor. The buildings and chimney are of brick; the latter is 150 ft. high, 6 ft. internal diameter at the top, and has been designed to be large enough for a considerable increase in boiler power. The contract for the destructor cells and boiler plant was carried out by Messrs. Meldrum Bros., and included two double-cell refuse furnaces, fired from a firing floor above, on to which the rubbish is tipped direct from the tipping floor; the draught for the refuse furnaces is supplied by means of a 7½-H.P. motor-driven fan. Each pair of cells is connected with a Babcock & Wilcox water-tube boiler of 250 H.P., with a heating surface of 1,760 sq. ft., and with independent grates for coal firing if required. The working pressure of the boilers is 150 lb. per sq. in. Feed water is obtained from an artesian well, and stored in three 400-gal. tanks. The boilers may be fed as desired by Holden & Brooke injectors, or by a Weir feed pump having a maximum capacity of 1,700 gals. per hour.

The engine-room plant, as originally installed by Messrs. Noyes Bros., of Dunedin, consisted of two high-speed single-acting triple-tandem compound engines of the Peache type, built by Davey, Paxman & Co., of Colchester, and direct coupled to 100-KW. Westinghouse dynamos, each capable of



The Boiler House, Christchurch Electricity Works, N.Z.

giving 400 amperes at 250 volts. The rapid increase in the demand has necessitated the addition of a third generating unit, consisting of a 250-H.P. Davey-Paxman engine, direct coupled to a 150-KW. B.T.-H. dynamo, which is now in service. The exhaust steam from the engines passes into a Blake & Knowles surface condenser, with steam-driven pumps. The circulating water is obtained from an unusual source, viz., the street side-channels, which, owing to the universal use of private artesian wells as a source of domestic water supply, are always full; the two which pass the station carry 12,000 to 15,000 gals. per hour, which gives the necessary vacuum in the condenser. In order to enable the engines to be shut down at night, a Tudor type storage battery has been installed which has a capacity of 1,200 ampere-hours, being the largest hitherto installed in Australasia. Two motor-boosters are provided for charging the battery without interfering with the supply to consumers; these each consist of a 50-H.P. shunt-wound 220-volt motor, driving a 36-KW. shunt-wound booster-generator, with a capacity of 300 amperes at 120 volts.

The whole plant is controlled by means of a switchboard consisting of seven marble panels, as follows:—one for each dynamo, one for the battery control, one for the booster motors, and two for controlling the feeders.

The daily output of the generators and battery is recorded by means of Thomson watt-hour-meters, the same type of meter being used in each consumer's premises. Electrical energy is distributed partly by underground, and partly by overhead feeders. From the switchboard, two pairs of armoured lead-covered 61/12 S.W.G. feeders, laid direct, lead to feeder pillars, consisting of iron boxes, containing a marble fuseboard from which the various circuits are taken off. In this way, underground junction boxes are dispensed with, and every distributor is protected by fuses.

A few underground distributors consisting of lead-covered cables, laid solid in bitumen in Totara troughing, are employed, but the majority of the distributors are run overhead, being carried up the poles in 2½-in. iron pipes from the tops of the pillars. The distributor sizes are 19/12, 19/14, 19/16, 7/14 and 7/16 S.W.G.; they are insulated with rubber, about three miles of weather-proof braided cable also being employed. The poles consist of machine-turned ironbark supplied from Sydney, and varying in length from 25 to 35 ft., and 4 in.-7 in. to 6 in.-10 in. diameter, costing 30s. to 70s. each.

The cross-arms are 3 in. × 3 in. × 36 in.; red gum timber was employed at first, but owing to its shrinkage Jarrah has been substituted, with very satisfactory results.

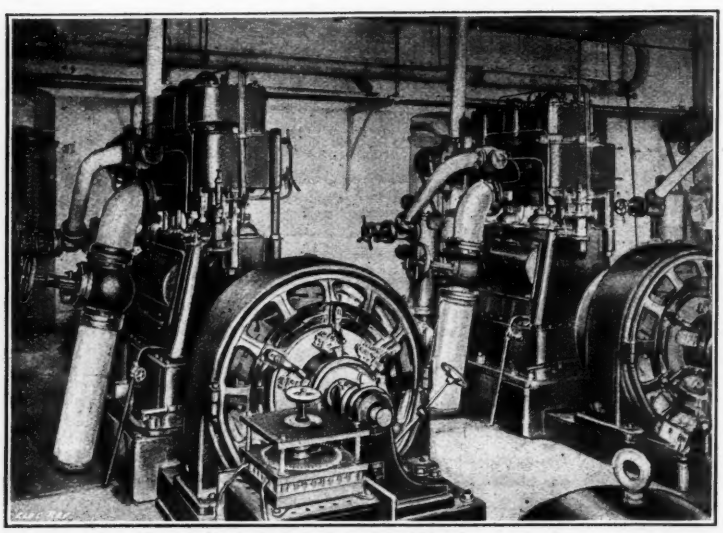
Supply is carried on under a Government licence of extraordinary stringency, not only in regulations controlling the street work, but extending to minute details of the consumers' wiring. As a result all wiring is being carried out on the distributing board system, with 8-light circuits, the distributing boards being in all cases of marble. Another clause of the licences specifying that all fuses shall be of the spring-clip type has resulted in the extensive use of Dorman-Smith and similar fuses in place of the ordinary open wire fuses, and, on the whole, the standard of house-wiring throughout will be very high.

The tariff is now as follows:—For light, 7d. for the first 500 units, 5d. for the second 500 units, and 4½d. for all over 1,000 units, with a discount of 1d. per unit, and for power a flat rate of 3d. per unit with 25 per cent. discount—*i.e.*, 2¼d. per unit net.

The result of these charges has been an extraordinary development of the motor load; the all-day motor output now exceeds the maximum lighting load on week evenings. The 98 lighting consumers connected, include the City Council Chambers, the Post Office, the Hospital, the University Laboratories, the new Roman Catholic Cathedral, the tramway car-sheds, five hotels, one theatre, one church and one hall, as well as shops, offices and private houses. The 69 power consumers include six engineering works, three foundries, five printing works, two boot factories, four clothing factories, four sawmills, two church organs, three lifts, one automatic sewage pumping plant, and 12 private pumping plants.

Direct-current Generating Plant, Christchurch, N.Z.

Mr. Lawrence Birks, B.Sc., A.M.I.C.E., acted as electrical engineer to the Council from the inception of the scheme until appointed consulting electrical engineer last June, when the active control was taken over by Mr. W. D. Wilkinson.



Peache-Westinghouse Generators, Christchurch Electricity Works, N.Z.

LEGAL.

Robert Cort & Sons *v.* Holford.

The hearing of this case, which was commenced on January 25th, and continued on January 26th, at the Mayor's Court before the Common Sergeant, sitting without a jury, was resumed on February 12th. A report of the first two days' hearing appears in the Electrical Review for February 1st. The action was brought by the plaintiffs, a firm of electrical engineers, to recover the sum of £18 17s. 2d., being the balance of an account for a private electrical installation supplied to the defendant and erected by the plaintiffs at his house in Essex. The defendant, by his defence, disputed certain items, in particular a claim for £6 12s. 6d. for an automatic cut-out, and £1 5s. for a shunt resistance, on the ground that the plaintiffs had contracted to erect a complete installation for £146 16s. and that these items could not be charged as extras. He also alleged that the plaintiffs were not entitled to deduct trade discount in respect of certain electrical fittings supplied; and he counterclaimed for certain costs alleged to have been incurred, owing to the plant put in having proved to be defective.

Mr. W Valentine Ball appeared for the plaintiffs; Mr. C. B. Marriott for the defendant.

On February 12th, counsel on either side having addressed the Court, the Learned Common Sergeant (Mr. Bosanquet, K.C.) in giving judgment, said that the contract between the parties was to be gathered from two letters and a tender. Although it was partly verbal and partly in writing, he would have to be guided by what was written at the time. According to a letter of February 13th, 1906, the plaintiffs undertook to provide a complete

plant at the defendant's house for the sum of £146 16s. The offer of February 13th was undoubtedly for a complete installation; the plaintiff, who knew little of electric lighting matters, had to rely upon the defendants to give him one. The offer was accepted with a variation on the following day (February 14th), the variation being that the size of the battery would have to be increased, which involved the price of the installation being increased by £10 5s. So far as price went, there was no other variation. The plaintiffs did not supply the engine which was to drive the dynamo. The defendant, instead of going to a contractor to supply a complete plant, including engine as well, bought a second-hand engine and took his chance. The plaintiffs had described the various items in their specification which went to make up the sum of £146 16s.; but that did not relieve them of the necessity of supplying everything reasonably necessary for a complete plant. They said the cut-out and the shunt resistance were rendered necessary by the variation of the contract. There was no contract that the installation should be put up to work with the particular engine which the defendant had bought. He was clear, upon the evidence, that the engine was not, at first, sufficiently powerful to work the installation. That, in his opinion, got rid of the counter-claim. While the engine was running inefficiently it was possible that it made it more difficult for the plaintiffs to get the best work out of the dynamo, and increased the necessity for a cut-out and resistance. As, however, he thought a cut-out and a resistance should have been supplied as part of the complete installation, he would reduce the plaintiffs' claim in respect of these items, which came to £9 13s. 6d., to £4 13s. 6d. He also allowed the plaintiffs' claim for lamps supplied. With regard to the fittings, the plaintiffs sought to charge the defendant the full retail price. They admitted that in getting the fittings from the General Electric Co. at a discount of 33⅓ per cent., the ordinary trade discount was obtained. In his view the plaintiffs were entitled to that discount. The conversation between the parties was, no doubt, as Mr. Holford said, namely, that the plaintiffs should order the fittings direct. The defendant could not have got the trade discount. It was common knowledge that makers when they supplied through the trade allowed a discount. Had the fittings not been so ordered, the defendant would have had to pay the full price. Of course they might have made an allowance because of the introduction, but there was no evidence of that. What the plaintiffs meant was: "We won't charge you anything more than they would, and we shall put the fittings up for nothing." Upon this issue, therefore, he found for the plaintiffs. In the result there would be a verdict for the plaintiffs on the claim for £11 12s. 6d., and a verdict for the same parties on the counterclaim. Costs to follow the event.

An Apprentice Case.

At the Guildhall on 12th and 18th inst., Francis Delme Radcliff, 39, described as an electrician, of 60, Glenfield Road, Dover, was charged, on remand, on a warrant, with obtaining several sums of money by false pretences. He appears to have called himself an electrical engineer and contractor, and in October, 1905, he took a room on the third floor at 69, Fenchurch Street, at a rental of 8s. 6d. a week, and professed to trade as the Electrical Installation Co. He advertised in the daily papers for apprentices at small premiums, and the inducement held out was that wages were to be paid immediately. In that way, during the past year, he obtained six apprentices and an aggregate sum of £71. He was doing no work at all, and the only instruction he gave the apprentices was to show them the fixing of electric wire in his office. It appeared that being unable to pay his rent, he removed to 14, Aldgate Avenue, where he took a small room at 8s. a week, and the whole stock-in-trade and tools used in the business were conveyed by two apprentices to the new office in a couple of small bags. Defendant here professed to carry on business as the Electrical Wiring and Maintenance Co. He continued to advertise for apprentices, although those still on his hands were pressing for the return of their money, finding that they had nothing to do. The City police are conducting the prosecution. Prisoner was committed for trial.

Factory Act Prosecution.

At the Derby Borough Police Court on 6th inst., Messrs. William Rickard & Co., Ltd., manufacturers of electrical wire and cables, of Derby, were summoned, at the instance of Mr. W. S. Smith, H.M. Inspector of Factories, for having employed two females, contrary to the provisions of the Factory and Workshops Act, on January 30th. Mr. Smith gave evidence to the effect that the girls were allowed to work between the hours of 6 a.m. and 6 p.m., with the usual intervals for meals. Under the Act no females were allowed to work overtime, and in this case they were both under 18 years of age. He saw the manager, who said he was away at the time, and was unaware what was being done. He expressed his regret, and it was on that account that only two summonses were issued. There were other girls at work when he arrived, but servants of the company managed to get them away. Mr. Ducker, for the defendants, admitted the offence. In May, 1902, the defendants were fined 20s. and costs in seven similar cases. They were now fined 20s. and costs in each case.

Lloyd's *v.* Marconi International Marine Communication Co. and Another.

The hearing of this case was commenced before Mr. Justice Kekewich in the Chancery Division of the High Court of Justice last week. After learning what the action was about, his Lordship intimated that he thought it was a case for settlement. An adjournment was thereupon made to see whether his Lordship's suggestion could be acted upon. As no settlement was arrived at, the hearing was resumed on Thursday last, February 14th.

Mr. P Ogden Lawrence, K.C., and Mr. Ashworth James appeared for the plaintiffs, and Mr. Warmington, K.C., and Mr. Gover for the defendants.

The action was brought by Lloyd's against the Marconi International Marine Communication Co., Ltd., and Marconi's Wireless Telegraph Co, Ltd., and the claim was for specific performance of an agreement of September 26th, 1901, made between the defendants on the one part and the plaintiffs of the other part, of certain terms of compromise of two actions, Lloyd's *v.* the first named defendants, and Lloyd's *v.* the second named defendants, whereby the first named defendants, with the privity of Marconi's Wireless Telegraph Co, Ltd., agreed to equip the plaintiffs' signal stations at the North Foreland, the Butt of Lewis and the Flannen Islands with the Marconi wireless telegraph apparatus. An injunction was also claimed restraining the defendants, their servants, agents and workmen from carrying on wireless telegraphy at or near the North Foreland elsewhere than at the plaintiffs' signalling stations or otherwise, so as to prevent the wireless telegraph apparatus being installed and worked at the plaintiffs' stations.

The Wireless Telegraph Co., Ltd., had disclaimed any interest in the proceedings in this action, and proceedings against them had therefore been discontinued.

In opening the case, Mr. Lawrence, K.C., said the question to be decided was whether, under the agreement entered into between the parties, the Marconi Co. were bound to establish their system at the North Foreland. Lloyd's had a signal station there, and under the agreement they claimed the right to have the Marconi system established at this station. Counsel referred in detail to the statement of claim, which set out the relations between the parties.

From the statement of claim it appeared that the two defendant companies were, as regards administration, in the same hands, but, by Clause 1 of the agreement, the International Co. granted to Lloyd's the right to use the Marconi system for the sole purpose of maritime signalling at all Lloyd's signal stations then already established, or to be established, during the currency of the agreement (which was to run for 14 years) in any part of the world, with certain exceptions. Clause 2 provided for the speedy installation of the apparatus, payment for which was to be made by Lloyd's. Clause 3 fixed the rate of payment and royalties for the installation in respect of each signal station, and Clause 6 set out that before October, 1901, Lloyd's were to give the International Co. an order for an installation in at least 10 Lloyd's signal stations. By Clause 7 Lloyd's undertook not to use at any of their signalling stations any system of wireless telegraphy except the Marconi system. Certain delays took place in naming the 10 stations, and in 1904 an action was commenced by Lloyd's against the International Co., and in 1905 an action was instituted against both defendants, both actions raising various matters. The actions were stayed on the terms of a single agreement of compromise, which provided that, except so far as it modified the provisions of the terms of compromise, the agreement should continue in force during the remainder of the original term, the royalties on the 10 stations to continue payable at five of the stations to be named by Lloyd's. It was alleged by the plaintiffs that they had paid to the International Co. the royalties on the 10 stations, and that they had named the five stations which were to be equipped under the agreement. One of the five stations was the North Foreland, and plaintiffs said that the International Co. had refused to install the Marconi apparatus at Lloyd's stations at the North Foreland, and that the defendants were working the Marconi system at the North Foreland, and claimed the right to do so notwithstanding the agreement.

The defendants, by their statement of defence, did not admit that the administration of the defendants' two companies was in the same hands. They did not admit that the agreement was entered into with the concurrence of the Wireless Co. They also said that prior to the agreement of 1901, the International Co. had established a station at the North Foreland, which had been worked regularly, and they contended that by one of the clauses of the agreement it was expressly agreed that the station at the North Foreland and all the then established stations of the International Co. should continue to be worked either by the International Co. or by Lloyd's on their behalf. The defendants said that in pursuance of an agreement and with the desire to work amicably with the plaintiffs and to work all Lloyd's stations as well as their own, they were willing, circumstances permitting, to remove their own wireless telegraph station to Lloyd's Watch House premises at the North Foreland, but litigation having been renewed between the parties, the International Co. determined to continue their own station at the North Foreland. The Postmaster-General had agreed to grant a licence to the International Co., but had refused to permit the establishment of more than one wireless telegraph station at the North Foreland, and the defendants said that by reason of such refusal they were unable, lawfully, to equip and establish wireless telegraphy at Lloyd's station.

Mr. Justice Kekewich said he understood that what plaintiffs insisted upon was that the Marconi installation should be established at Lloyd's signal station at the North Foreland.

Mr. LAWRENCE: Yes, under the agreement. Lloyd's, after experimenting with other systems, were willing to adopt the Marconi system at their station at North Foreland, and they desired to have this system installed.

The learned counsel proceeded to deal with the terms of the agreement, and complained that the defendants' station had been removed without plaintiffs' knowledge. If the defendants were right in their contention, they would render the whole of the agreement nugatory.

Evidence was called in support of the plaintiffs' case.

Mr. JOHN PUTT, examined by Mr. LAWRENCE, said he was at present engaged at Malin Head, on the north-east coast of Ireland, and had been in Lloyd's service as signalman for 20 years, and had been attached to various Lloyd's stations. In November, 1904, he was placed in charge of the Marconi wireless station at North Foreland, which was about a mile inland from Lloyd's station. He remained in charge of the Marconi station near Kingsgate, until it was removed to Lloyd's station. The transfer took place on March 13th, 1906.

Will you tell his Lordship what the Marconi station consisted of?—It was an ordinary private house, and had a vacant piece of land next to it, and was at the end of Percy Avenue. The front room was used as the instrument room. Next to that there was another vacant piece of land, and on that stood a mast which was about 140 ft. high. Marconi's moved down to Lloyd's station, and Mr. Kapp, of the Marconi Co., superintended the removal. They had only one assistant operator at that time. When they had got the instruments in position he worked the section for about a month. During that month the working at the station proved to be satisfactory. It was his duty to make weekly reports to Lloyd's, and during the time he was there he made such reports.

WITNESS was questioned as to the farthest distance at which he communicated with ships going up and down the Channel, and replied that 80 miles was the farthest. The average distance at which they wanted to speak to vessels was from 30 to 70 or 80 miles.

WITNESS added that Marconi's kept an operator at the North Foreland station where there was a mast 140 ft. high.

Did you get into difficulty with the Marconi people through getting into communication with vessels at too great a distance, and was a notice posted up in the instrument room?—Yes.

Mr. Justice KEKEWICH: I suppose they were, in fact, poaching.

Mr. LAWRENCE: Yes, my Lord.

WITNESS said the effect of the notice was that they were told not to communicate with vessels beyond the distance of 30 miles. For all purposes for Lloyd's maritime signalling, the station at which witness was working for a month was quite satisfactory. At Malin Head, where he was in charge, there was a mast 120 ft. high which had been erected in a much more exposed position than the North Foreland. The representative of the Marconi Co. came down about March 16th. At that date the Marconi mast was still standing on the vacant plot of land at Kingsgate. He had a conversation with Marconi's man, who looked at the size of the land on which the mast was erected, and this representative of Marconi's, Captain Daly, said it would be better if the mast were somewhat larger. Captain Daly did not say anything about putting the mast up on a different site. Shortly after Captain Daly's visit, men commenced to take down the mast on the Kingsgate site. After it had been taken down, the mast lay on the vacant land for some two or three weeks, and when they got it away it was taken to the site at which Marconi's had now got their station, and was there erected. When he saw what was being done he made a report to Lloyd's. The instruments were taken out of Lloyd's station and put on the Trinity House site about April. That was as soon as the mast was completed. Mr. Kemp, the superintendent of the Marconi Co., directed that to be done, and superintended the re-erecting of the mast. Witness had no instructions from Lloyd's about that, and he assumed that the work was being done with Lloyd's authority. Witness continued to work at the station till June of that year, and then he went to Malin Head.

Cross-examined by Mr. WARMINGTON, K.C., WITNESS said he did not know the North Foreland in 1901. He only went there in the summer of 1904. There was then a Lloyd's signalling station, but that was not in operation. When he was appointed in 1904, the signalling station was in operation. He did not think it was managed on behalf of Lloyd's by some of his predecessors. So far as he knew, prior to that wireless telegraphy at that station had been worked by the Marconi Co. It had been in use by Marconi's people for some years.

Asked whether there was or was not room for two wireless telegraph stations at the North Foreland, and whether, if there were two, they would not "jam" each other, WITNESS said, if there were two worked together, they would "jam" each other.

Counsel directed witness's attention to a letter of December 4th, 1905, in which witness had stated that he did not realise that one of the five stations named by Lloyd's was the North Foreland, as there was obviously no room for another station, and that he took the mention of the North Foreland station to be a slip. He was asked what he meant by that, and he replied that he did not think there was room for two stations. The two could not be worked together at the same point.

By Mr. WARMINGTON: Wireless telegraphy includes both maritime signalling which was Lloyd's part, and sea signalling which was Marconi's part. These two can be done at one station.

Dr. MURRAY, a consulting electrician, said there was no difficulty in rigging up Marconi wireless telegraphy at Lloyd's station.

This concluded the case for the plaintiffs, and

Mr. WARMINGTON, K.C., proceeded to open the case for the defendants. He said the whole question was which station was going to be closed. It was admitted on both sides that the two could not work together side by side, as the one would kill the other. Was the Marconi station going to be closed or was it Lloyd's station? His submission was that they found the equipping of Lloyd's station meant the killing of the Marconi station. One of them must undoubtedly give way, and he submitted that Lloyd's must give way and not the Marconi Co., because there was an express stipulation that they were to be at liberty to carry on their station.

Mr. HENRY CUTHBERT HALL, who said he had been for many years managing director of the Marconi Co., explained that he was responsible for the working, on his side, of the agreement of 1901 which had been put in. Eight stations were in existence at the date of the agreement, and they had been selected with a view to commanding a certain telegraph apparatus for communication with ships. Those stations were Caister, Withernsea, on the east coast, North Foreland, Niton, and Lizard on the south coast, and Cookhaven in the South of Ireland. There was no wireless telegraph station at any of the places, but he believed there were Lloyd's stations there. North Foreland had been established in 1901. Witness had had practical experience with regard to wireless telegraphy, and he heard the evidence as to the mode of fixing the site at Trinity Lighthouse.

Asked whether the apparatus which was placed at their own station was transferred to Lloyd's and subsequently removed to Trinity House, Witness replied that that was so, but stated that there was no charge made by his company in respect of that apparatus or in respect of the costs of equipment or installing.

Cross-examined by Mr. P. OGDEN LAWRENCE: My friend stated in his opening statement, and I suppose you will agree with it, that you had at the date of the original agreement three stations working along the south coast?—Yes.

What height of mast at these stations had you?—The masts were from 150 to 180 ft. in height.

Can you tell me what is the distance you can communicate with a mast 150 ft. high?—With the kind of apparatus we use, about 150 miles.

You use a term called "jamming." Is that a term used with reference to the confusing of messages?—That is the term used when two messages are superimposed on the same receiver.

Mr. LAWRENCE: You can communicate a greater distance the higher you go?—WITNESS: Yes, within certain limits.

If a 150-ft. mast was working at one place and another 150-ft. mast was working about 150 miles off, would the messages from the first mast interfere with the message from the second mast?—No, they would not. You mean if the same tune were being used.

COUNSEL: Yes.—WITNESS: I don't quite understand the question.

My question is this: Assume a mast was erected, say, at the North Foreland, and another 150 miles off and 150 ft. high, if they were working with a proper apparatus would the working of the second mast interfere with the working of the first?—WITNESS said that if the message were for a ship a message could be received from both stations, but the strength of the signals of one station would be greater than the strength of the other. The weaker signalling would be cut out. Two messages could be taken on the receiver.

I thought that was the cause of the "jamming?"—It is.

You could not read either; there would be confusion of the two signallings?—Stations 150 miles from each other could interfere with each other, but they would not because of the arrangements that were made.

I am talking of stations that are in opposition to each other. Could not they interfere?—They could interfere.

If 250-ft. masts were erected 75 miles from each other, working in conjunction with one another, would not the one spoil the other's work?—Certainly.

Which were the five stations of Lloyd's, established by you under the agreement of 1901, when the compromise of 1905 was arrived at? One place in the south of Ireland, Malin Head in the north, and Innistrabul on the west, were three of them?—Yes.

When did you equip the South of Ireland one?—Probably about 1902 or 1903.

Did you understand that naming the remaining of the five stations in accordance with the agreement involved an order of Lloyd's that you should equip the stations so named with Marconi's system?—I did not understand it.

What did you understand the naming of the five stations was?—I understood the naming of the five stations to be an expedient on the part of the secretary of Lloyds to avoid fulfilling the terms of the compromise. It was not a definite order which we intended to act upon.

Do you say that seriously?—I do.

Although there was a clause that Lloyd's was to give an order for the installation of the Marconi system?—Alternative arrangements were discussed, and they discussed the selection of the stations.

You seriously want my Lord to believe that having got this agreement, they did not involve an order from Lloyd's to equip these stations?—It was not intended to be an order to act upon, neither were Lloyd's in a position to give an order to equip any of these stations—except four.

Why do you suggest they could not give an order?—Because they required a licence for all the places they named, and they had not a licence for any one of them.

And you say it did not involve an order from Lloyd's to install?—I did not, because he went on to discuss the variation of the list.

His LORDSHIP: Do you say it was an evasion of Lloyd's?—WITNESS: I would not say it was an evasion, but they had been

five years in naming the stations. We had not a definite list of stations they wanted to equip.

Counsel then read a letter from Sir Henry Hosier, which was written, he said, with reference to the agreement, and offering to give instructions to one of his men to give the necessary facilities for entrance to proceed with an installation.

Witness was asked if he gathered that Sir Henry Hosier thought it was being equipped as one of the five stations in Clause 19A.

You have got a plain intimation that the North Foreland is one of the five stations to be installed under Clause 19A?—Yes.

Do you say that was not an arrangement made between you and Sir Henry Hosier?—I do.

Can you show me any letter with reference to that?—I don't think that letter was sent to me at all. We were advised not to communicate with Sir Henry Hosier at all, except through our solicitors.

That was not answered at all by you?—Except through our solicitors. Witness added that they had had about five thousand letters regarding the stations to be equipped. He wrote that his company would not have the North Foreland as one of the stations.

Can you point out any letter written by yourself, or anyone on behalf of the company you represent, showing that you would not have the North Foreland as one of the stations?—I can produce letter books in which I wrote to Mr. Chubb.

His Lordship: You know what the question is. You know perfectly well that the letter written by you to Mr. Chubb is not a letter written by you to Lloyd's.—Witness said he stated that they had hundreds of letters from Lloyd's, giving the list of stations. He did not probably consider what they wrote, but he considered what they (defendants) had written. He had written to his solicitors saying that Lloyd's could not have the North Foreland station.

His Lordship: In the hope of helping you, I will give you an opportunity of putting yourself right.

Mr. Lawrence: Is it not a fact that you never communicated to Lloyd's at any time that you declined to accept the North Foreland as one of the five stations?—Mr. Chubb wrote a letter in which he intimated that in the naming of the North Foreland station, Lloyd's had made a mistake.

Did you send down a man to inspect the ground?—Yes.

Did you see his report when he came back?—I cannot say whether I did or did not. I was aware that a report had been made, saying that the site was unsuitable.

Why didn't you communicate that to Lloyd's?—Because Capt. Daly, who discussed the matter with me, did not agree with the report.

You didn't communicate that you had had a report to Lloyd's?—No.

On March 13th, when under your instructions, Lloyd's station was equipped, were you still willing, according to your letter, to close your own station and equip Lloyd's, or had you changed your mind?—My recollection is, that we found there was no room to spare.

Mr. Justice Kekewich: You don't expect us to believe that?—Witness: It is easily understandable.

His Lordship (warmly): A man of your intelligence ought to be ashamed of yourself.

Mr. Lawrence: I ask you, were you still prepared to close your own station and equip Lloyd's?—No.

I want to ask you when you changed your views, which you had expressed on December 20th, 1905 (reading from a letter), "We are quite prepared to close our own station and equip yours." Tell me when you changed your mind.—We never changed, for I never intended to equip Lloyd's.

There is a statement of December 20th in your own handwriting. Were you on March 13th still prepared to close your own station and equip Lloyd's? You said no. I want to ask you when you changed your views with regard to equipping Lloyd's.—I said "to move into your station and close our own after equipping yours."

If you are not going to answer, I shall go on. When did you communicate with Trinity House with a view to getting an adjoining site?—I have no notion as to the date.

You want to represent to my Lord that you communicated with Trinity House before you went into Lloyd's station?—I did not represent that.

Mr. Lawrence: Are you trying to answer my question or not? If you are not, I shall sit down. I will give you your letter of March 19th to help you. Counsel read a letter which stated:—"Referring to your letter of the 25th, our intention is to maintain a station at the North Foreland distinct from Lloyd's signalling station. We don't consider Lloyd's has been suitable." Is that the first time you notified Lloyd's as to the suitability or unsuitability of the station?—Apparently.

In re-examination Witness said if different stations used different tunes "jamming" was unavoidable [? avoidable.—Eds.] if they were equi-distant. In the case of two stations near one another if they were communicating with a ship at the same time there would be mutual interference.

Counsel: If stations near one another used different tunes would they "jam?"—It depends on the tunes.

This concluded the evidence.

Mr. Glover, addressing his Lordship, said it was perfectly true that the defendants shifted their station at the North Foreland, but it really made no difference whatever, this station being really the same station. It all came down to the fact that they had got their North Foreland station already established. Lloyd's called upon them to equip their station. The answer to this was that they would not do it for it would be impossible to work both stations. It would be impossible to get a licence for an additional station, and the defendants were therefore entitled to stand on their rights. The clause on which the plaintiffs had relied should, he submitted, be construed reasonably and consistently, and having regard to the whole nature of the agreement. If it were so construed he believed that his learned friend's contention in this action would be found to be absolutely wrong, and that the defendants' refusal was perperfectly justifiable, and that they were not bound to close their station.

Mr. Justice Kekewich then gave judgment. He said the only difficulty in the case had been in appreciating the position of the defendants. It went without saying that he followed Mr. Warmington's opening of the defendants' case very closely. It was clear, ingenious and forcible, and there was nothing left in the case which remained to be said, but he (his Lordship) failed to understand the force of Mr. Warmington's contention. He thought there must be something in the defendants' case which he had not seen, and so he took the opportunity of quietly considering the agreement, and the view which he then formed of the proper construction of the agreement confirmed what he had said. The only thing he could agree with Mr. Glover in, was what he had said with regard to the construction of the agreement, viz., that it should be considered as a whole document, fairly and reasonably according to the canons of construction. It seemed to him that the agreement admitted of only one possible construction with reference to the point under consideration. In considering all agreements it was proper and right to have regard to the surrounding circumstances, even though they were not stated. They all knew who the parties were and the circumstances under which the action was brought. They knew that Lloyd's had a large number of stations in the United Kingdom and elsewhere, and they knew that one of these stations was the North Foreland, which was described in the schedule as "temporarily suspended." It was impossible to say, however, that because it was temporarily suspended, it was not one of the stations referred to in the agreement. No one would say that the agreement admitted of any such construction as that. They did not know the stations of the Marconi Co. though they knew they had stations, because they were mentioned in Clause 13. One station on the experimental list was at the North Foreland. In passing, he noticed one point which was made a good deal of—the identity of the two different stations, because the Marconi Co. now had a station on the site, which was not the same as that at the date of the agreement. It was said, however, to be the same station, and that the company had only changed the site. That seemed to be a play upon words, and to his mind it was a different station. But he did not think anything turned upon it, because the same results would follow if it were the new station or the old station. He now desired to turn to the agreement, the general purport of which was simple enough. Lloyd's had under consideration the introduction into their service of wireless telegraphy. The Marconi system was not the only system. Lloyd's had spent money on ascertaining which was the best, and had come to the conclusion that Marconi's was the best, and were, therefore, prepared to throw to the winds expenses in inquiring into other systems, and to adopt the Marconi system, and to confine themselves to using that, paying certain sums for the privilege. The Marconi Co., on the other hand, were willing that their system should be used at Lloyd's stations on certain terms. They were in doubt, however, whether Lloyd's would adopt the system at sufficient stations, and so make it a commercial success. They, therefore, stipulated that whilst Lloyd's should be at liberty to adopt the system at any number of stations, they should compulsorily adopt it at 10, and, of course, it followed from that that Lloyd's should pay for the system at 10, whether they adopted the system at the 10 stations or not. He took it that the legal result from that would be that if Lloyd's did not adopt the system at more than nine, there could be an action by Marconi's for breach of contract. So the bargain was that Lloyd's should be at liberty to use the system at all their stations, but were bound to use it at 10, these 10 being entirely of their own selection. Was it possible on the construction of the agreement that the defendants meant that Lloyd's should be at liberty to use the Marconi system at all stations except the North Foreland, and that they should be bound to use it at 10 stations other than the North Foreland station? He could not himself see the slightest ground for any such supposition. The contention was based on Clause 13, but it seemed to him that if it meant anything as regards the North Foreland, it meant that Lloyd's might work the wireless telegraphy there. How it could be said that there was any exception in the case of the North Foreland he failed to understand. To his mind, this argument was quite inconceivable. Clause 2 provided for the payment for the installation and for the payment of a royalty of £20 a year for every station where the system was adopted. He had already stated the substance of Clause 6, which provided for the adoption of the system at 10 stations. Clause 7 was important, because it bound the plaintiffs down to use the Marconi system. Clauses 9 and 10 ought not to be overlooked, though they only provided for the wishes of the company; and the business of the company had been quite different from that of Lloyd's. Beyond that there was nothing in the agreement. The parties had some litigation, and arrived at a compromise. The compromise was embodied in a long agreement of 22 clauses, two only of which seemed important in the present action. Up to that time, Lloyd's had not fixed on the 10 stations. They had only fixed on five. That was a breach of the agreement—a breach, of course, which the Marconi Co. were entitled to complain of. It was an actionable wrong, and the Marconi Co. might have recovered damages. When the litigation was compromised the Marconi Co. stipulated that these five stations should be added, and what was more, they reasonably stipulated, and the stipulation was admitted. The remaining five were to be named by Lloyd's at any time before the drawing up of the order in law. Now, why was the North Foreland not to be

included? Why except the North Foreland? He could not conceive the slightest reason for it, and it seemed to him when he looked at the surrounding circumstances that there was no intention to exclude the North Foreland from the agreement. There might have been under the original agreement because the Marconi Co. had a station at the North Foreland and they might have wished—although they did not say so—to exclude the North Foreland, but when the next agreement was signed it was a full agreement. There was no reason why it should not be included, and also whether he took the exact words of the agreement or the surrounding circumstances the same conclusion followed. It seemed to him that what had happened was this: That after an interval during which the Marconi station at the North Foreland was transferred to that of Lloyd's, the Marconi Co. had established a new station close by—for this purpose he did not care whether it was the old or the new station—and were there carrying on their business. It had been proved beyond doubt, by uncontradicted evidence, that the two could not stay there together. He put aside the question of getting a licence, but they could not be carried on because the Postmaster-General's licence was not forthcoming. What the position really amounted to was this—if the Marconi Co. carried on their business on their new site they would interfere with the work of Lloyd's. It was said that Lloyd's would interfere with the Marconi Co., but it seemed that the Marconi Co. had not the right to be where they were. The Marconi Co. would interfere with Lloyd's; yet was that a thing which ought to be allowed? It was obviously not very good behaviour, but the question was whether there was any legal wrong, and it depended upon the construction of the agreement. It might be doubted whether there was any negative agreement to be found; an agreement on the part of the Marconi Co. not to do anything which would interfere with Lloyd's working under the agreement which had been entered into between the parties. There was no negative term whatever in the agreement, so far as he had seen, except that Lloyd's should not use any other system. It seemed to him, however, that putting aside the obligation to maintain, Lloyd's were to pay certain sums, and therefore the Marconi Co. were bound to supply everything that was necessary to work the system. This meant that there was necessarily an implied agreement on the part of the Marconi Co. not to do anything to interfere with the privilege which they had assigned. They could not specifically perform the agreement, which was asked for, and he could not grant damages to the plaintiffs because no damages were proved. He could, however, grant an injunction, and he did so. He would agreeably leave the case there, but there were two points to which he must refer. In the first place, it was put forward that the Marconi Co. was justified in what they had done because their system could not be adopted at the Lloyd's station. Now, he had uncontradicted evidence that there was not the slightest difficulty in putting up a proper mast on the site occupied by the North Foreland station of Lloyd's, and, therefore, there was absolutely nothing in the objection. Why the defendants had taken the course they had taken he did not know. There was evidently considerable jealousy on the part of the Marconi Co., for there was no doubt whatever that the North Foreland was named distinctly by Lloyd's according to the terms of the agreement. It was named in a solicitor's letter, and it was also named in a letter from Sir Henry Hosier, written on behalf of Lloyd's to the managing director of the Marconi Co. There was a certain amount of correspondence between the parties, but from first to last there was no statement on behalf of the Marconi Co. that it was not competent for Lloyd's to name the North Foreland as being one of the stations within the terms of the agreement. There was also nothing amounting to an intimation by the Marconi Co. that it was impossible to enable the North Foreland to come within the agreement. The point had been made in Court, however, but his conclusion was entirely adverse to the Marconi Co. He wished to say as little as possible about what happened that morning, but the case was an important one, and it might come up in the Court of Appeal, and an importance might be attached to evidence which he did not attach to it, and the question would be asked, "What was the opinion of the Judge?" He must, therefore, say enough to answer that question. Nobody could doubt that Mr. Cuthbert Hall was a shocking bad witness. He talked instead of answering questions, and endeavoured to argue instead of leaving it to his counsel. It would have been an insult to his intelligence to say he did not understand the plain questions put to him. He allowed himself to say he did not understand things he must have understood, and he avoided direct questions whenever he could. His Lordship then granted the injunction with costs.

Mr. Warmington asked that the injunction should be stayed for a fortnight.

Mr. Lawrence: I shall not object, because we want the rights decided between us.

His Lordship assented.

Furse *v.* Thorpe.

At the Nottingham County Court last week his Honour Judge Allen delivered judgment in an action brought by W. J. Furse, electrician, of Nottingham, against Sidney Thorpe, electrician, of Mansfield, to recover £32 7s. 8d., the price of goods sold and delivered. The action had been commenced in the High Court, and remitted to the County Court. In October last, by consent, the case was adjourned on the understanding that the solicitors should meet and arrange what was admitted, disputed items being referred to Mr. Leman, as arbitrator. Plaintiff now asked that judgment should be given in accordance with the arbitrator's award. His Honour gave judgment for £31 4s. 2d., the amount of the award with costs to be taxed by the Registrar.

In *re* S. G. Brown's Patent 1,434 of 1899, and in *re* the Patents, Designs and Trade Marks Act. Petition for Revocation.

A petition for the revocation of this patent came before Mr. Justice Neville in the Chancery Division on Thursday, February 14th.

Sir Robert Finlay, K.C., Mr. Cripps, K.C., and Mr. Walter, K.C. appeared for the petitioners; Mr. Bousfield, K.C., and Mr. J. C. Graham, K.C., for the respondents; and Mr. E. Russell Clarke held a watching brief on behalf of the Commercial Cable Co.

The onus being on the respondent, Mr. Bousfield opened his case. He said there were a great many technical matters involved in it with regard to electricity in connection with signalling cables. The invention in question had reference to the sending of signalling currents through long submarine cables, and according to his case, the inventor, Mr. Brown, had solved a problem of the greatest possible difficulty which many inventors had been endeavouring to solve for years before, who had found no practical solution of it up to the date of Brown's patent. He would call experts to say that, up to the date of Brown's specification, this was an unsolved problem. They knew all the cables in the world, and nobody could do it before this patent. He had said the invention belonged to long cables; that meant to cables something over 1,000 miles in length. To solve a similar problem on land was an easy matter, and to do the thing with short cables was comparatively an easy matter, but to do the thing with long cables was a matter of the greatest difficulty. Brown's invention was now applied to three-quarters of the long cables in the world. It had been recognised as furnishing the solution of the problem, by the great cable companies of the world working under the invention and paying large royalties for it. The cable companies paid altogether to them £7,000 a year in royalties, and he should think it could not be disputed that the cable companies were the people who could best form an opinion as to what was known before the date of this invention. Dr. Muirhead said there was no subject matter in the invention, and said it was all to be found in the old specifications he (counsel) would tell his Lordship about. The date of Brown's patent was January 21st, 1899. Then there was a patent of Dr. Muirhead, No. 596 of 1899, dated January 9th. Then there was another patent of his, No. 9,525 of 1899, dated April 10th. There was this peculiar thing about what the petitioner had said. Dr. Muirhead was saying that Brown's invention was contained in his patent of January 9th, 1899, and that he was the first and true inventor. They had carefully searched that patent, and they could not find it there. His Lordship would hear the evidence of experts on the subject. An important part of the invention was certainly in the patent of April 10th. They went before the Controller, and objected to those claims, and the Controller struck them out. He then passed to uncontroversial matters. In electrical engineering they had to deal with certain elementary things such as shunts, coils, magnets, keys, condensers and things of that kind which were more or less simple in themselves, but those fundamental elements could be combined in an infinite number of ways. The learned counsel then proceeded to draw his Lordship's attention to the relation between a magnet and a current, when the hearing was adjourned.

Mr. Bousfield, continuing his opening address on February 15th, said the main object of the invention was to do for cables in the way of relaying what had been done for landlines. One of the difficulties at the outset was that while in landline circuits they got currents of the order of a milliampere available for energising the electro-magnet, which was to work the relay, when they got two cables, instead of having currents of the order of a milliampere, they had an available current of only a microampere, which introduced a great difficulty, because the thing that was going to work the relay was the current, that had to work the contact device which was to send the current on. If they had currents of the order of a milliampere it could be done by means of the thing he had shown his Lordship. But if there were only currents of a microampere, as they had in submarine cables, then the driving power was only a thousandth part of what it was in landlines.

His Lordship: What is it reduces the current?

Mr. Bousfield: The resistance, and something else, too.

His Lordship: And loss?

Mr. Bousfield: Loss in a curious way. Your Lordship has asked me a question which brings me to some of the difficulties in cable work. Continuing, the learned counsel said the cable was lying at the bottom of the sea sheathed with rope, gutta-percha and so on. Outside that was the sea itself, and they made the return through the sea. They did not have a return cable, except in a few cases, for very short lengths. They did not have a return cable; as in landlines, they had an earth plate at one end and an earth plate at the other. When the current was sent through the cable, it came back through the earth, so that there was on all sides of the cable what might be called a difference of potential. There was a difference of electrical condition. When it came to working a relay or trying to work a relay from the cable, it introduced a great difficulty, the first being that they had such very small currents to energise their apparatus. The second great difficulty was that the zero was a varying zero. To get rid of the varying zero was one of the difficulties in trying to get over a cable relay. That was how the matter stood for a great many years, and various people tried to solve the problem. In 1899

Bright said "with a view to effecting automatic instead of manual translation between lengths of submarine line, the cable relay may be said to have been the dream of the cable manager for years, and one that has seriously occupied the mind of many an electrician. The late Mr. C. V. de Sauty, Mr. Walter Field, Mr. Chas. Cuttriss and Mr. E. Raymond-Barker had especially turned their attention to the subject, but so far, no absolutely complete success had been met with in practice." That was guarded language, but he might add to it that no proposition had been so successful that any cable company would have thought of applying it to the actual practical working of their cable. The first idea that occurred to the experimenter was naturally a relay with fixed contacts; but, as Mr. Cuttriss had expressed it, the "stiction" here involved must always be fatal to success. Both Mr. Sauty and Mr. Raymond-Barker had endeavoured to turn the suspended coil to account with a cable current. It would seem that though it was possible that the cable relay might be applicable to short circuits, in the case of really long cables it did not appear as though it would be possible to obtain impulses sufficiently clear to operate any dead-beat relay such as would be required to actuate signalling lines.

His Lordship: What is a dead-beat relay?

Mr. Bousfield: I am told it is one that makes a distinct signal, that is, is thrown over from one side or the other. His clients, the owners of this patent, were Mr. Taylor, Mr. Dearlove and Mr. Brown, the inventor, and these gentlemen, who were with Mr. Brown, had been at this problem for years. He would call Mr. Walter Judd before the close of the day, as he was going abroad. He was the manager of the Eastern Telegraph Co., and he himself had tried to do the thing. The only evidence he wanted to get from him was to the effect of the paragraph he had read, that this had been the dream of the cable engineer for years, that he and several others had tried to solve the problem, that they had failed to do so, and that until the date of Brown's invention the problem remained an unsolved one, whereas now it had been completely and satisfactorily solved by the invention of Mr. Brown. The main points to be got rid of were the difficulty of working with the extremely small current, and the difficulty of the varying zero. It was said that Mr. Brown had been anticipated, because it was a well-known thing that all they had to do in order to get a relay to work was to have a vibratory contact, and that although they had very little power to move it, the vibratory contact was the thing to solve the difficulty. They all tried vibratory contacts, but Brown was the first to pass from the vibratory contact, which had failed, to the idea of a continuously moving contact, which succeeded. The idea of Mr. Brown was opposed to all ideas of vibratory contact which had been tried before; it was to have a continuously moving drum, on which the contact should be made. The drum in the apparatus was divided into two parts by an insulating section. It was not until Mr. Brown introduced the conception of a metallic drum divided into two sections continually revolving that the problem was solved. After Mr. Brown had made this a success, Dr. Muirhead himself abandoned his idea of vibrating contact. He did not venture to make the thing. He wanted the patent repealed in order that he might. What he patented was a drum, and instead of continuous rotation, he moved it backwards and forwards. That was nearly the same thing. Whether it was an infringement or not, they did not trouble about, because it would only complicate matters. But he wanted to point out that what Dr. Muirhead—who had been for many years a most experienced person in electrical signalling, and, he supposed, the man to whom the cable companies had gone for many years for all sorts of apparatus until Messrs. Brown, Taylor & Dearlove succeeded in bringing their apparatus before the electrical companies—what he had to come to practically was the form of moving the drum backwards and forwards. Mr. Bousfield next referred to the point as to the varying zero, and said that it occurred to Mr. Brown that he could get rid of that by means of an application of the principle of the inductive shunt. Brown's idea was to put an inductive shunt with a large iron core in it so as to have very high inductance. Dr. Muirhead said it was common knowledge. They all knew what an inductive shunt was, and they knew that the higher the inductance the more it choked, and so on. Those were the elements he had told his Lordship at the beginning, but the inventor had to combine those elements in a particular way to make the invention. Every possible ground of attack had been taken against the specification. The learned counsel then read the complete specification, which said: "This invention relates to improvements in telegraph apparatus whereby the relay apparatus is capable of being worked efficiently by minute electrical forces such as are likely to be received at the ends of long submarine cables, and is also capable of working with an absolute certainty of contact, which is not in such cases obtainable with delicate relays when fixed contacts are employed. My improvements also relate to means for eliminating a varying zero in the recording instrument, and for obtaining a better definition of the signals than heretofore." That was a general description of the whole thing. The varying zero part was put separately from the relay point, because it was useful not only for a portion of the relay, but also where the relay was not used. The device, so far as the removal of the varying zero was concerned, was claimed independently of the relay, because it was used independently of the relay, as well as with the relay. Mr. Judd would tell his Lordship that if he could have taken Dr. Muirhead's apparatus instead of respondents', he would have done so. He was a personal friend of Dr. Muirhead. Dr. Muirhead and his family had done a great deal for the advancement of electrical matters in connection with cables and the duplex system, and had earned a great reputation in connection with them, and what Dr. Muirhead and his firm did not know about signalling through cables, no engineer was likely to know. That, however, did not refer to things that had to be invented, but to things which were matters of knowledge in connection with cable engineering.

(To be continued.)

Deep Leads Electric Transmission Co., Ltd.

The petition for the winding-up of this company, which has stood over from time to time, was mentioned in Mr. Justice Warrington's Court again on February 12th. Mr. Romer, K.C., said negotiations were thought to have finally broken down, but he was glad to say they had been re-opened, and there was every prospect of success this time, and if the matter was allowed to stand over for another fortnight they believed it would be definitely settled. It was a case which obviously ought to be settled. They had represented in Court every person who could conceivably be interested.

Mr. Gore Brown, K.C.: We have the evidence all ready, and if we want to fight we can do so next time.

Mr. Buckmaster, K.C.: I appear for very large contributories, and there is no prospect of mischief to outside creditors.

The petition stood over accordingly.

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Cramp Neutralised Repulsion Motor.

I do not feel that I have been "convicted" of any misstatement by Mr. Fynn, and the supposed fallacy in my "phase" diagram rests solely upon the assumption that he can make good his statement of May 18th, 1906, to the effect that "the total leakage field can only form a small part of the total field threading the armature." It is this latter statement that we are still differing about.

The motor does not admit of two conflicting theories, of course, and the truth is that Mr. Fynn never will be convincing until he gives up his long arguments concerning the various phases and puts his reasoning into concrete geometrical or algebraical form.

The former I have done twice, giving him two diagrams which I believe to be theoretically correct; and I have also tried to understand his recent exposition. I am, however, entirely at a loss to discover what Mr. Fynn means by the quantity ϕ_l'. Is it in phase with the secondary current?—because, if so, it may be taken with ϕ_3. Or is it in phase with the primary current? If so, then it may be resolved into two portions, one to be taken with ϕ_0', and the other with ϕ_3. Or is it in phase with ϕ_0'? If so, then the magnetising current must increase very much from 0 to full load in order to carry this greater flux across the air-gap. This, however, I think Mr. Fynn does not believe to be the case so long as the primary voltage is constant and primary resistance small.

I will now ask Mr. Fynn to put down, in as short a set of algebraical expressions as possible, his exact theory of the motor, or else to express his views by two phase diagrams for constant voltage, one at no load, the other at maximum power factor, both drawn to scale. If he demur to this as being my duty, then I have pleasure in directing his attention to the following simple theory of the machine expressed in Steinmetz notation, and I will ask him to name that quantity which corresponds to his ϕ_l'. Vectors not fully written out are shown by dotted capitals. Let—

ϕ' = the R.M.S. value of that flux which threads the primary coil and limb 2.
ϕ'' = the corresponding value for limbs 2 and 3.
N = frequency of supply.
n = total number of turns on limb 1 = total number of turns on limb 3; ratio 1 : 1 for simplicity's sake.
n_1 = number of armature-turns in series.

A bi-polar motor is assumed, and iron losses and resistance losses are for the moment neglected.

Then the E.M.F. of reactance of limb 1—

$$E' = \frac{2\pi N n \phi'}{10^8}, \quad \ldots \quad \ldots \quad (1)$$

E.M.F. of rotation due to this same flux—

$$= \frac{4\, n_1 N_1 \phi'}{10^8}; \quad \ldots \quad \ldots \quad (2)$$

E.M.F. of reactance of limb 3—

$$E'' = \frac{2\, \pi N n \phi''}{10^8}, \quad \ldots \quad \ldots \quad (3)$$

E.M.F. of rotation due to this same flux—

$$= \frac{4\, n_1 N_1 \Phi''}{10^8}. \quad \ldots \quad \ldots \quad (4)$$

Also, if R be the reluctance of limbs 1 and 2 and limbs 3 and 2 respectively (assumed equal for simplicity) so that

$\frac{10^8}{R}$ = number of C.G.S. leakage lines per amp.-turn,

$$\text{then } \phi' = \frac{n\, I\, 10^8}{R} \text{ and } \phi'' = \frac{n\, I_1\, 10^8}{R},$$

where I and I_1 are the primary and secondary currents respectively.

Inserting these values in (2) and (4) and calling x the reactance of primary and secondary coils respectively, we get—

$$(2) \qquad = \frac{2}{\pi} \frac{n_1}{n} \frac{N_1}{N}\, x\, I = q\, x\, I,$$

similarly (4) $= q\, x\, I_1$, where q is a simple numeric.

From this we get the vector E.M.F. equation for the secondary circuit: $2\, q\, I_1\, x + q\, \dot{I}_0\, x - \dot{E}_1 + I_1 j x = 0$, where E_1 is the induced E.M.F. in coil B, and I_0 is the magnetising current.

From these equations we deduce at once that so long as I_0 is reasonably small compared with I_1 the power factor is determined by—

$$\tan a = \frac{I_1 x}{q\, I_1 x} = \frac{1}{q};$$

so that it is only necessary to have (with ratio of transformation = 1) the product $n_1 N_1$ large compared with $n N$ to obtain a high power factor. On the other hand, the torque is given by the vector product $\dot{I}_1 [\phi' + \phi'']$ so that under the above conditions it is proportional to I_1^2 within the limits of saturation. If the reactances of primary and secondary are not equal, the torque may be more nearly proportional to I^2, and this is the case, although the armature reactance is supposed neutralised. This is my theory in brief, and these are the characteristics I expect.

It is only necessary for me to add that I_1 will tend to get into quadrature with ϕ_m only at very high speeds, beyond the point of maximum power factor; and that I ignore Mr. Fynn's suggestion that I added arithmetically where vector addition was purposely denoted by a bar.

William Cramp.

Manchester, *February 15th*, 1907.

Jerry Wiring.

With regard to the remarks made by your correspondent about jerry wiring, it has been the practice for years to heap coals of fire on the head of the poor wiring contractor, oftentimes for occurrences for which he is in no way to blame. I recently had occasion to inspect a number of installations carried out with a certain foreign manufactured wire; this wire was sold to the contractor as high-class material, equal to wires of the best English manufacture, and, as far as outside appearances went, this was undoubtedly the case; as a matter of fact, much of this wire is got up to please the eye and deceive the senses.

While little or nothing could be found unsatisfactory with the way the wires had been installed and the work fixed, experiments with the wires revealed a state of things which would account for much of what your correspondent complains of; for instance, on the 240-volt supply circuits, in places where the wires were exposed to a little damp, a spark could be obtained between the outer coverings of the wires of opposite polarity, the wire in steel tubing being the least satisfactory. The insulation material used would have given points to a sponge; in fact, it was nothing but sponge in action, if not in name. I believe it is the practice in America now to inspect materials as well as workmanship during the progress of installation, the supply engineers insisting on a standard of quality for materials as well as efficient fixing. If some such arrangement existed here, it would be better for everyone concerned, including the contractor.

It may be news to some of your readers to know that 5s. 6d. and 6s. a point is about the price for which electric lighting work is now being carried out in the London districts; this would be impossible if it were not for the jerry merchant with his rotten wares, whose one object is to make money, the wiring contractor very often being an unconscious victim and tool. The remedy is in the hands of the engineers responsible for an efficient and cheap electrical supply, and they should protect the consumer in the interests of the industry.

Outer London.

Technical Literature.

In your issue of January 25th, 1907, your correspondent "C. H. W." remarks that he does not often trouble you with a letter (it might be beneficial to the readers of the Electrical Review if he did). This is my first offence, so I hope to be pardoned for intruding. I wish to pile a few more "dittos" upon those contributed by "C. H. W.," with whom I cordially agree, except in his remark of "useless matter." This is a little too mild. "Rot" is hardly sufficient to express the value of some of the literature spoken about. I have some recollection that, 25 years since, the smallest value of an article in London was expressed by "not being worth a tinker's d—n"; perhaps this would apply better than "rot."

The contribution of "W. M. M." in your issue of January 18th, 1907, is a masterpiece of truth, and the sooner such publications as he quotes are boiled down to plain facts, and written by men who know what they are writing about, the better it will be for those who are anxious to get at the truth, and are compelled for business purposes to keep up to the times.

W. T.

Philadelphia, U.S.A., *February 11th*, 1907.

Electric Clock Installations.

Your issue of the 8th inst. contains a letter from the Magneta Co., saying that they have a larger installation of electric clocks than that erected by the Private Wire and Telephone Installation Co. in the new Liverpool Cotton Exchange. That may be so at the moment, but the Liverpool time-circuit is being rapidly increased, and will, I understand, shortly exceed that mentioned by your correspondent. The point of interest lies, however, not so much in its size as in its autonomy. The "Synchronome" installation is entirely automatic, whereas the "Magneta" requires daily winding.

There is another installation (of American origin) in this country which eclipses that of the Magneta in point of size, but, inasmuch as it also requires winding (though only once a week), it does not appear to be of sufficient scientific interest to justify description in the technical Press.

A much greater degree of accuracy in time measurement is required in an automatic system than one in which daily or weekly attention is given, and that feat is accomplished in the "Synchronome" system by a happy combination of a switch and a pendulum, which eliminates all troubles due to failing contacts and batteries.

F. Hope-Jones, M.I.E.E.

London, E.C., *February 12th*, 1907.

Wireless Telegraphy and the Admiralty Agreement.

I think it is almost unnecessary to point out that "Your Correspondent" is still evading the issue.

He must show, not that there is apparatus other than jiggers and Leyden jars which the Admiralty is free to purchase from parties other than the Marconi Co., but that there is no apparatus other than jiggers and Leyden jars which the Admiralty is under legal obligation to purchase exclusively from the Marconi Co.

He wrote of the legal obligations of the Admiralty to the company in November, 1906, and said: "It (that is, the Admiralty) is still under agreement with the Marconi Co. in certain respects; but it is not compelled to purchase any more apparatus from that company except jiggers and trays of Leyden jars."

That is the statement he should prove or withdraw.

Jiggers, Leyden jars, and coherers are not the only articles required for wireless telegraphy; there are many other articles, and he does not make good his statement by declaring or proving that the Admiralty purchases coherers from parties other than the Marconi Co.

At the time "Your Correspondent" wrote, the Admiralty was under obligation to purchase apparatus other than jiggers and Leyden jars exclusively from the Marconi Co.; it is still under this obligation, and it has purchased many thousands of pounds' worth of such apparatus—patented wireless telegraph apparatus.

"Your Correspondent" suggests that I can safely abuse him, because he does not sign his name. He can easily deprive me of this safety, and if he will sign his name, and acknowledge the authorship of the original communication and the subsequent letters, I will not only agree that all I have written applies to the person who admits the authorship of "Your Correspondent's" communications, but I will characterise his statements in terms such that, if not correct, I should render myself liable for serious consequences.

It is a waste of time to pursue this controversy any further. I will merely conclude by saying that I have adopted "Your Correspondent's" recommendation that the attention of the Admiralty should be directed to my statements, and have sent to it a copy of "Your Correspondent's" original communication and the subsequent letters. Needless to state, the Admiralty does not traverse my statement, nor support "Your Correspondent's."

Probably "Your Correspondent" will send a letter next week saying that someone in authority in the Admiralty declares the contrary; but that letter will no doubt be anonymous, and an anonymous letter of that character is worth less than the paper it is written upon.

Marconi's Wireless Telegraph Co., Ltd.,
H. Cuthbert Hall, *Managing Director.*

London, E.C., *February 18th*, 1907.

Rail Corrugation.

I have read with great interest the correspondence in your valuable paper, and am surprised to see the subject end as it did, viz., with a letter from Mr. J. E. York, of the York Transverse Rolling Process Co. There have been several ideas put forward, and, in my opinion, some have approached the correct theory, but have ended without the slightest hint at a cure. With your kind permission, I venture to reopen this correspondence, as it is a national subject. I would like to ask your readers whether they ever saw a straight rail, or an inside rail of a curve, or whether any rail on a curve of less than 250 ft. radius corrugated? I am greatly interested in this subject, as it is part of my daily duty to walk over 10 or 12 miles of track, and to report on the condition of same. I have come to the conclusion that the cause does not lie with the track, but in the car wheels. These wheels, being fast on the axles, cannot possibly run evenly on a curve. The outer wheel must gain the difference in the length of the two rails, and not being able to follow the rail, must "jump or skid," and this causes the corrugation. It does not matter in the least how little curve there is, even if it is only a rail slightly out of line on an otherwise straight road, this trouble will be found to exist, and as some of your correspondents have said, the indents are all one measurement, viz., 2½ in.

At the commencement of a curve, or where the track is out of line both ways "S" shaped, and the cars travel quickly over the spot, the "inner" rail will be found to be "hollowed out or waved" in patches about 6 in. long, and the distance this occurs depends wholly on the speed of the cars, which oscillate from side to side until finally settling down to the curve or road. It would be a very expensive experiment to take damaged rails out of the ground, and send them to the York Co. to be re-rolled; in fact, it would cost more than new rails, and in case of this being done, the rails put in the place of those sent to be treated would be just as bad in a few months' time, if the car wheels were allowed to remain as at present "fast."

Perhaps some of our tramway or electric railway engineers will see what is meant, and if this idea is taken up seriously, I venture to say that we shall hear no more of roaring rails.

Inspector.

Metallic Filament Lamps.

I would point out to "Inquirer" that, by taking thought, he could obtain a great range of efficiencies and candle-powers by running a tantalum and carbon filament lamp in series with each other, say—

100-volt tantalum } 220 volts, or
120 „ carbon }

90-volt tantalum } 200 volts, or
110 „ carbon }

20-volt tantalum } 200 volts, or
180 „ carbon }

any other range of combinations that may suggest itself.

These should be put together in a globe of a diffusing type to neutralise the difference in colour of the two filaments.

There would also be the advantage that in the case of breakage of the filament, one lamp only need be replaced, an advantage not shared by the composite lamp.

Also, can Mr. Harrison tell us, in the case of the composite lamp, whether if the tantalum filament breaks, it is likely to join itself to the carbon filament?

Whether the addition of the carbon filament to the tantalum enables it to be burned more satisfactorily on alternating current?

Whether the fact of the two filaments burning in one bulb has any effect on the life or behaviour of either?

A. H. S. C.

February 16th, 1907.

One hesitates to add to the sum of extraordinary statements and questions that find their way into print, but, at the risk of being ridiculous, I must ask Mr. F. Harrison how, with his "composite" lamps, he got over the difficulty which I should have thought would have arisen with the ageing of the carbon filament and its increased current consumption?

I believe this increase is not nearly as marked with the metallic filaments, and should imagine that to attempt to run the two filaments in series, for any length of time, would be quite useless.

Wonderful things can be achieved by way of experiment, but it is quite a different thing to develop that experiment into a commercial article—and it is this, I take it, that "Inquirer" was suggesting.

Jas. Bastian.

Manchester, *February 15th*, 1907.

Shift Engineers.

I was very glad to see a letter in your "Correspondence" columns by "One Who Storms," *re* the difficulties of obtaining a berth as shift engineer, on account of one's deficient experience (on paper). I think the same remarks apply in the case of engineers-in-charge. Certain berths are advertised, and it is stipulated that "applicants must have had experience in" a certain class of machinery. Now, a properly qualified engineer should be capable of taking charge of all and any kind of machinery, for if he is put in charge of a special kind, strange at first to him, he should not be long in finding out the why and wherefore of everything, that is, if he is interested in and loves his profession, which all true engineers should do.

Then there is another point I should like to see debated in your columns. Advertisements (of a certain class) often state "copies of three recent testimonials to be enclosed." In the first place, what is the earliest date one could reasonably call recent? And is one supposed to be constantly

changing jobs in order that the date of the testimonial may not be too antiquated? My experience of engineering firms is that they do not give written testimonials (they may be hawked all over the country for years). There is nothing to prevent them, however, from giving a reference, providing one has left of one's own accord. The failure to produce these written testimonials may be the death-blow to many a "capable aspirant" who has, perhaps, worked on all sorts of jobs under all sorts of conditions and had the best all-round experience fitting him to take charge of a steam plant. I cannot think that engineers have the wording of these advertisements, or if they have, they are unconsciously unaware of the disappointment they are giving to many a young engineer who wants a chance to "take charge."

Also, having in view the recent scandals exposed in a certain Union *re* appointments, would it not be as well to enclose a £5 note with the application, just to go on with—I mean, of course, when applying for a post under a public body? Under these conditions it is useless trying to seek a permanent berth under a Corporation or other public body. As "Shifto" says, it is a waste of time and money trying to improve oneself in order to be an engineer-in-charge.

These remarks must not be taken as being written in the heat of the moment or under a great disappointment, but have been the thoughts for years of an

Engineer-in-Charge.

Electrical Development Association.

It would no doubt be a most desirable achievement to found in England an electrical development association on similar lines to those obtaining in America, and referred to in your last issue by Mr. Borlase Matthews. Of course, some of the features would have to be modified to suit English ideas of commercial and financial propriety, *e.g.*, the percentage contribution according to sales, &c. Now, many of our big manufacturing and contracting firms would squirm at this proposal because of its giving away their private concerns too much. A better way, perhaps, to arrange the contributions would be a very small percentage on their paid up capital, or a levy on the basis of their average publicity appropriations for the past five years. But it will be a very ticklish matter to get all the interested parties into line, and no matter what scheme is proposed, of fixing the proportion that each firm is to contribute, there will be many objections thereto. To this association the municipalities ought to be called upon to contribute; the debates thereon will no doubt provide much "divarshon" for both municipal reformers and municipal enterprisers alike. However, to bring such an association into being will require a Heaven-born tactician, and much give-and-take between all the interested parties.

C. Rockley.

Electricity Offices, West Ham,
February 13*th*, 1907.

Dignity in Debate.

The Saturday *Westminster Gazette* once offered a prize for invective. A glance through a few weeks of your "Correspondence" columns leads one to opine that quite a number of electrical engineers could win this without effort.

I purposely refrain from referring directly to any person or persons, but could you not alter this? It should be possible for opinions to be ventilated, and points of view set forth, without personal abuse.

The frequent gibes and taunts made at anonymous correspondents are not assurances of authenticity on the part of those who make them. The identity of all correspondents is known to yourselves, and if you consider a man to be of sufficiently good standing to write in your columns, I say that he is of sufficiently good standing for others to reply to, and that in a reasonable and civil manner. For, after all, a letter in these columns is a public letter, and a reply to a letter written over a signature is no less public than a reply to one written over a *nom-de-plume*. It is, of course, a very different thing when anonymous letters are received privately.

In your issue of January 25th, "C. H. W." pertinently observes, anent technical literature, that "the amount of utterly useless matter printed is nothing short of criminal; the effect is to render it impossible for a busy man to read anything." If you do not think my letter is too great an addition to this criminally large amount of twaddle, you will, perhaps, insert it; and I may as well say here, in anticipation of replies which may be written, that I am open to argument, but impervious to sneers, although my feelings are not in the least dulled by reason of the anonymity which, for my own reasons, I deem it necessary to preserve.

What I want to see in your "Correspondence" columns, though I do not wish to be taken as boasting its possession —"Ubique" must tell me if the Latin is wrong—is—

Dictio cum Dignitate.

[We entirely agree with our correspondent, and we have often urged correspondents to keep to the point and avoid personalities. He sees only what we publish; we wonder what he would say of the tirades that we *withhold* from publication!—Eds. E.R.]

Sensitive A.C. Voltmeter Wanted.

I am anxious to get a low-reading voltmeter suitable for alternating currents of about 40 ~ per second, but independent of the frequency; range about 15 to 50 volts.

It is necessary that the instrument should only require a very small current, say not more than 0·001 ampere for 50 volts, or else it should be electrostatic.

It is most important that it should be very dead-beat, so as to give its readings very quickly.

I do not know of any instrument that fulfils these conditions, but shall be glad if any of your readers can inform me where such an instrument may be obtained.

Research.

February 18*th*, 1907.

Mica Insulator Co, Ltd., v. Geo. Schultz & Co.

We beg to inform you that on February 13th an order was made in the above action that the plaintiffs be at liberty to discontinue the same, with costs to be taxed and paid by the plaintiff, and no further action to be brought.

As announcements of the pendency of this action, which was for alleged infringements of the Mica Insulator Co.'s patents, have from time to time appeared in the technical Press, and were calculated to interfere with our business, we shall be glad if you will give the above intimation that the action has been disposed of in our favour, full publicity.

Sole Agents for Meirowsky & Co.
George Schultz & Co.
D. N. Schultz.

London, E.C., *February* 18*th*, 1907.

PARLIAMENTARY.

Cavehill and Whitewell Tramway Bill.

An interesting point was decided by Mr. Campion, the Examiner of Standing Orders, on Thursday last week in the case of this Bill, which was opposed by the Belfast Corporation on the ground that standing orders had not been complied with.

Mr. Cripps, who appeared for the Belfast Corporation said that tramways were first instituted in the city in 1872, and were then in the hands of a company. Certain portions of the company's system extended beyond the boundary along the Antrim Road. At a later date the Cavehill and Whitewell Tramway Co. was authorised to construct a line which was really a continuation of the Belfast Street Tramways Co.'s line. In 1896 the boundary of the city was extended so as to include not only the portion of the Belfast Co.'s line, but also a portion of the Cavehill Co.'s line. In 1904 the Corporation of Belfast and the Belfast Tramway Co. came to an arrangement under which the whole of the tramways of the company were transferred to the Corporation, and the Corporation were authorised to reconstruct the tramways and work them by electric traction. The Corporation, however, did not take over

any portion of the line of the Cavehill Co. The Corporation had electrified the lines, and were now working them. In 1902 the Cavehill and Whitewell Co. also obtained powers to electrify their tramways, and had now done so. When the Corporation were making the alterations for their tramways in the Antrim Road, where the Cavehill tramways commenced, they took up the then existing lines and replaced what was then a single line, with a double line, but the physical connection between the old horse lines of the two companies was no longer maintained. The Bill now before the Examiner proposed running powers by the Cavehill Co. over certain lines of the Corporation, but these powers could not, of course, be exercised, because there was no physical connection. By Clause 6 of the Bill, however, the company proposed to place an obligation on the Corporation to "reinstate and restore that recently closed tramway" so as to form a junction or connection between the two undertakings in the Antrim Road. His contention was that if the Corporation put down again what they took up in that road, it would give no physical connection between the two systems. The line which the Corporation took up was a single line, and the tramway of the Corporation, as it existed now, was a double line. If the single line which was taken up were relaid, the centre of the single line would come exactly between the two double lines of the company. There was considerable discussion a few years ago as to the exact effect, from the point of view of Standing Orders, of the reconstruction for the electrification of tramways. Some people expressed the view that it was an alteration of tramways which required plans to be deposited, and others said that the tramway was in the road, and it was, therefore, merely a question of alteration, and no plans were required. It was ultimately decided, he believed in the case of the Birmingham Tramways, where there was no opposition, that plans were not necessary where the alterations proposed were merely the alteration of the construction. In the case now before the Examiner, however, there was not only nothing in the street at all in the way of a tramway at this particular point, but the obligation of the Bill could only be effected by putting down something in the street which never was there before. To make the object of the Bill effective required the construction of a double line of tramway. His friend might, as other people had done, rely on the fact that this was only a very little one. It was true that there was only 10 or 15 yds. between the ends of the two systems, but whether it was 15 yds. or 5 miles the principle was the same, and he agreed it was a new tramway which was proposed to be laid in the street. Accordingly he asked the Examiner to rule that this was a Bill of the second class, and that inasmuch as no plans had been deposited the promoters had failed to comply with the Standing Orders.

The City Engineer for Belfast produced plans showing the road in question.

Mr. Cameron (Sherwood & Sons), for the promoters, examined witness with a view to showing that it was the original intention of the Corporation to connect the tramways.

The Examiner said that after looking at the plans and hearing the statements, he did not consider the Bill one of the second class, and accordingly overruled the objection.

Mr. Cripps made a second allegation that the notices in the *Gazette* were erroneous and misleading, inasmuch as there was nothing to show that tolls and rates would be collected by the company on Corporation tramways.

Mr. Cameron argued that the notice was sufficient, inasmuch as the company only asked to exercise the existing powers of the Corporation.

The Examiner overruled the objection.

Mr. Cripps took a further objection to the notice regarding Clause 6 of the Bill, where it was proposed that the Corporation should be required to lay the line, and pointed out that the notice was entirely silent as to costs.

The Examiner applied the objection of the Corporation on this point, and also on a further point relating to the superintendence of the construction of the line by the company's engineer.

The Bill will accordingly have to go before the committee on Standing Orders, who will decide whether the promoters shall be allowed to proceed.

Opposition to Electrical Bills.

Practically all the petitions which will be forthcoming against private Bills have been deposited, and some idea may now be obtained of the opposition likely to be met when the Bills are before Private Committees. The following are amongst the principal opponents in the case of electric Bills:—

King's Norton U.D.C.—Shropshire, Worcestershire and Staffordshire Electric Power Co., Birmingham Tramways Co., Worcestershire County Council and Birmingham Corporation.

Rawtenstall Corporation.—Haslingden and Bacup Corporation, Lancashire and Yorkshire Railway, Lancashire Electric Power Co., and three others.

London and North-Western Railway.—Twenty-nine petitions, including the National Telephone Co., Middlesex County Council, London County Council, Metropolitan Railway, Hampstead and St. Pancras Borough Councils, Metropolitan Water Board, Midland Railway.

London County Council Electric Supply.—Eight-six petitions. The petitioners include practically all the local authorities who are affected by the Bill, whilst amongst companies who are opposing are Crompton & Co. and Electric Supply Corporation, Kent Electric Power Co., South Metropolitan Electric Tramways and Lighting Co., and British Electric Traction Co., North Metropolitan Electric Power Supply Co., Whitechapel and Bow Railway, companies supplying electrical energy in and in the neighbourhood of the county, the three London gas companies, Smithfield Markets Electric Supply Co., Twickenham and Teddington Electric Supply Co., London United Tramways and the Electromobile Co.

London Electric Supply.—Forty-six petitions. The petitioners are mostly local authorities, but include the National Telephone Co, the London County Council, and the City Corporation.

Lower Thames Tunnel Railways.—Opposed by the East London Railway, Great Eastern Railway Co., Metropolitan Asylums Board, London and Tilbury Railway, Millwall Dock, London and North-Western Railway, South-Eastern and Chatham Railway, and eight others.

Administrative County of London and District Electric Power.—Forty-eight petitions are presented against this Bill, the opposition being practically the same as against the L.C.C. Bill.

London and District Electric Power.—There are only eight petitions against this Bill so far, all of whom are local authorities.

London County Council Tramways.—London and Brighton Railway, Great Eastern Railway, Great Northern Railway, North London Railway, National Telephone Co., Midland Railway and 22 others.

North Metropolitan Electric Power Co.—Cheshunt U.D.C., Walthamstow U.D.C., West Ham Corporation, London County Council, Electric Supply Corporation, Herts C.C., Harrow Electric Light and Power Co., Metropolitan Electric Supply Co. and eight others.

Central London Railway.—National Telephone Co., London County Council, St. Marylebone Borough Council and two others.

Leicestershire and Warwickshire Electric Power.—Coventry Corporation, Leicester Corporation, and Leamington and Warwick Electrical Co.

London United Tramways.—Great Western and Metropolitan Railways, L.C.C., Surbiton U.D.C., Hammersmith Borough Council, Staines U.D.C., East and West Molesey U.D.C., and Metropolitan Water Board.

Watford and Edgware Railway.—Middlesex County Council, L.C.C., Hendon U.D.C., and two others.

Great Northern and City Railway.—London County Council and the Corporation of London.

Richmond (Surrey) Electricity Supply.—Richmond Corporation.

The following petitions have been deposited in the House of Lords:—

Electric Supply Corporation Bill.—North Metropolitan Electric Power Supply Co.

Manchester Corporation Tramways.—Cheshire County Council.

Middlesbrough, Stockton-on-Tees and Thornaby Tramways.—Middlesbrough Corporation.

Oxford and District Tramways.—Oxford Corporation (against alterations).

In the Private Bill Office of the House of Lords the National Telephone Co. has lodged petitions against the Barnsley, Wombwell, and Wath Tramways; the Middlesbrough Corporation, Middlesbrough, Stockton-on-Tees, and Thornaby Tramways; the Oxford and District Tramways, and the York District Tramways.

The trustees of the Earl of Egerton and the Earl of Ellesmere are opposing the Manchester Corporation Tramways Bill.

The Oxford and District Tramways Bill is also being opposed by the London & North-Western Railway Co. and the Conservators of the Thames.

Felixstowe and Walton Improvement Bill.—It has been intimated that this Bill has been abandoned. While the principal object was to obtain power to construct promenades, there was a clause for the confirmation of an agreement dated May 18th, 1903, between the Council and the Suffolk Electricity Supply Co., and for power to vary the agreement.

Edinburgh and Suburban Tramways Bill.—On Thursday last week this Bill should have come before the Examiner of Standing Orders, but there was no appearance, and the Bill was accordingly marked "dead." The proposal was to incorporate a company with a capital of £81,000 to construct tramways to be worked electrically.

Tunbridge Wells Corporation Bill.—The Bill of the above Corporation which contained a clause to enable the local authority to supply electricity outside the borough within the rural district of Tonbridge has been withdrawn.

Standing Order Proofs.—Mr. Campion, one of the Examiners, sat on Thursday last week to consider proofs of standing orders in the cases of various Bills postponed. The Middlesbrough, Stockton-on-Tees and Thornaby Tramways Bill was allowed to be further postponed for a fortnight on the understanding that if the consents are not then proved, the Bill would be marked as not having complied with standing orders. The Barnsley, Wombwell and Wath Tramways Bill was postponed for a week. The Glasgow Corporation Bill was found to have complied with all the requirements, but the Rawtenstall Corporation Bill was marked "non-compliance."

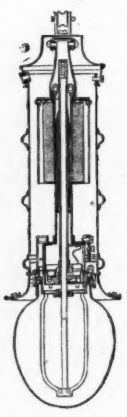
York and District Tramways Bill.—On Thursday last week the promoters of the York and District Tramway Bill came before Mr. Campion, the Examiner of Standing Orders for proof of compliance with standing orders in the case of their Bill which seeks powers to construct tramways in the City of York and the surrounding districts. Mr. Lees appeared for the promoters, and Mr. Pritchard for the York Corporation, who opposed the Bill. Mr. Lees said he was compelled to take a non-compliance with reference to all the tramways in the City of York, and he had not received the consent of the Dringhouses R.D.C. The West Riding County Council had given their consent as the road authority for the outside districts. The Examiner intimated that he would report to the House that the promoters had failed to comply with standing orders.

The Glasgow Municipal Telephone Service.—In Tuesday's Parliamentary papers Mr. Field asks the Postmaster-General on what terms officials of the municipal telephone service at Glasgow are being transferred to the Post Office service, and whether he will take such steps as will effectually prevent any case of hardship, collective or individual, to the present members of the Post Office engineering department. Mr. Sydney Buxton, in reply, states that the employès of the corporation telephone service are being transferred to the Post Office service in the first instance on the same terms and conditions as those which applied to their service under the corporation, and in any arrangements for their incorporation in the Post Office he will endeavour to see that injustice is done to neither the present nor future members of that service.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

"Helia" Enclosed Arc Lamp.

The "Regina" arc lamp, which is now in the hands of Messrs. Marples, Leach & Co., of 6, Victoria Avenue, Bishopsgate Street Without, E.C., is familiar to our readers as being almost perfectly



Section of the "Helia" Enclosed Arc Lamp.

air-tight, the whole of the mechanism being hermetically sealed. Hence fresh air cannot enter, the gas cannot escape, and the life of the carbons is increased to 300 hours, while the efficiency is greatly improved. This lamp takes 3½ to 8 amperes at 110 volts. The "Reginula" is a midget lamp of the same type, about 13 cm. in length, and burning for 30 or 40 hours; it takes 2 to 3 amperes at 110 volts.

A new pattern is now made, called the "Helia"; this is also an enclosed arc lamp, measuring 20 in. in length over all, and weighing 8 to 11 lb. The D.C. type operates singly on 110 to 250 volts, and in series on 200 to 300 volts; the A.C. type burns singly on 100 to 130 volts, and in both cases the current taken is 3 to 6 amperes, and the burning period is 60 hours. The carbons are very thin, giving a high lighting efficiency and a steady light. The only moving portion in the "Helia" lamp is the patent clutch, and the mechanism is very simple. The accompanying figure shows the lamp in sectional elevation.

The mechanism being entirely enclosed, these lamps are specially suitable for use out of doors, and for lighting rooms liable to damp and to corrosive fumes.

An Office Time-Saver.

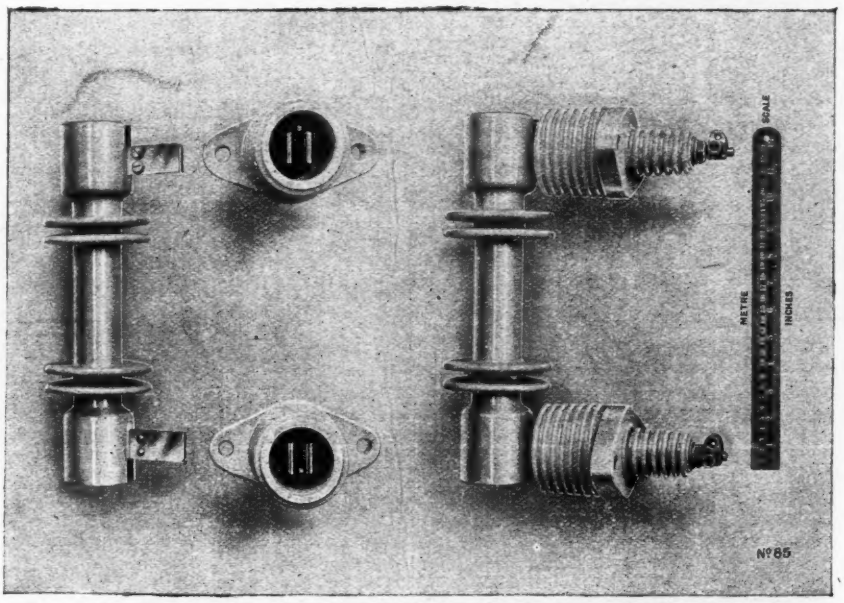
An ingenious device to stop one source of time-wasting in offices is being put upon the market by Messrs. W. Sanders & Co., Falcon Electrical Works, Wednesbury, who are sole manufacturers of a Telephone Message Tablet, an instrument which is, on the face of it, so useful as to make one wonder why its appearance has been so long delayed. The tablet, which hangs beside the telephone, as shown in the illustration, is made with walnut finish and nickel fittings. A self-winding paper roll, controlled by simple pressure of the writer's wrist, passes over a sheet of carbon paper, which duplicates the message. Messages of any length may be taken, for the carbon copy can be torn off where required, and the message delivered to the proper department. Should the message miscarry, the roll containing the original message may be readily referred to.

New "Shadoless" Candle Device.

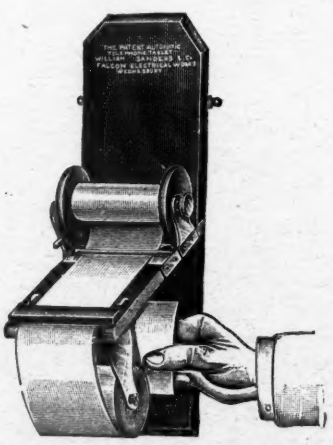
From Messrs. D. H. Bonnella & Son, Ltd., 58-60, Mortimer-street, W., we have received a leaflet describing a telescopic "Shadoless" candle fitting, which they have introduced with the object of facilitating the adaptation of various electric light fittings, which sometimes gives rise to considerable difficulties, especially where it is not practical to fit an S.B.C. holder. The upper portion of the interior is constructed on the same lines as their ordinary "Shadoless" type, and is mounted on a metal tube which slides into an outer tube, on to the end of which is attached a rubber end. This rubber end is placed between two brass screwed nuts, and when expanded (by screwing down the upper nut) securely fixes the fitting into the sconce. By using this type, perfect adjustment of the interior to the opal tube and sconce can be obtained, no matter what depth the interior is fitted into the sconce, while the appearance and effect are precisely the same as in the ordinary type.

H.T. Tubular Fuses.

The accompanying figure shows the new tubular fuses which have been introduced by Messrs. A. Reyrolle & Co., Ltd., of Hebburn-on-Tyne, for high-pressure circuits. It will be noticed that special attention has been given to the insulation, both of the porcelain fuse handle and of the insulated contacts, which are sunk deeply into the protecting cups. These fuses can stand 100 amperes at 3,000 volts, or 50 amperes at 600 volts.



Reyrolle H.T. Tubular Fuses.



An Office Time-Saver.

Automatic Motor Starters.

The Electrical Apparatus Co., of Caxton House, S.W., are introducing the "Sundh" starter, in which sliding contacts have been entirely eliminated. Even the smallest sizes are operated by means of a separate lever for each step. The contacts are all of carbon, and are easily renewable. In the larger sizes the main contact, which closes the field circuit and in switching off is the

last to break, is provided with a strong magnetic blow-out. After all the resistance has been cut out, a laminated copper brush short-circuits the starter.

Only one solenoid is required to operate the starter, and this, after the motor has attained full speed, is placed in series with a suitable resistance, thus bringing down the current consumption to

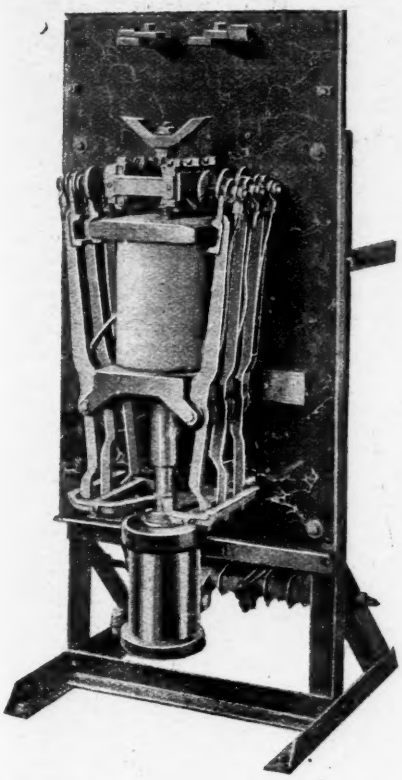


Fig. 1.—"Sundh" Automatic Motor Starter, Type B.

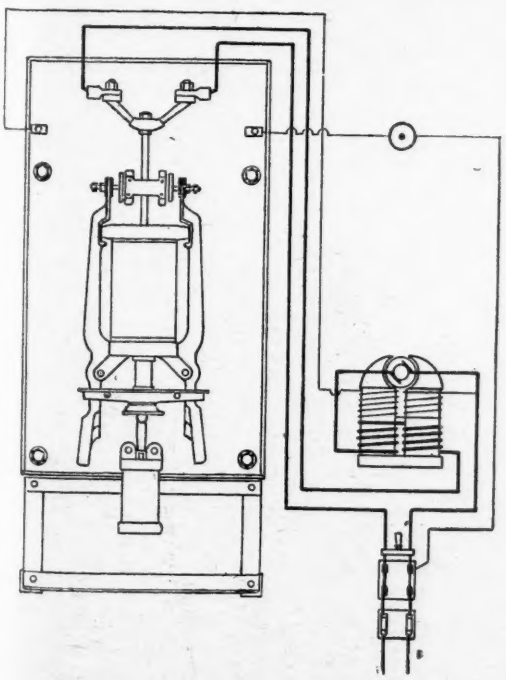


Fig. 2.—Diagram of Connections.

a negligible quantity; obviously the solenoid which operates the levers is *per se* a no-voltage release.

The construction of the "Sundh" automatic starter is compact and simple, consisting of a solenoid, a plunger with retarding dash-pot, and a number of levers hinged to the lower pole-piece of the solenoid. The upper ends of the levers carry the contacts, and their lower ends pass through a frame which is attached to the bottom of the plunger. For heavy duty the final contact is made by a laminated copper brush, which short-circuits the carbon contacts.

The solenoid becoming energised by the closing of a switch or a pressure regulator, begins to lift its plunger, the motion of which is retarded by an air dash-pot. As soon as the frame, which is attached to the base of the plunger, begins to move, one of the levers is released, and this lever being attracted by the magnetic flux of the solenoid makes the motor field and main-line contact. As the frame travels still higher another lever is released, which, in its turn, is attracted and cuts out a step of resistance, and so on, one lever after another being attracted until the whole of the resistance in series with the armature circuit is short-circuited or cut out.

When the circuit to the solenoid is opened, the plunger with its attached frame drops; as the frame goes down the lower ends of the levers are pulled inward, breaking the contacts in the reverse order to that in which they were made. As the contacts are broken the resistance is inserted in the armature circuit, so that the resistance is "all in" when the last lever breaks the main-line contact.

The magnetic pull on each successive lever is constant, and does not vary with the speed of travel, as the core, moving into the solenoid, compensates for the increased iron cross-section outside. Fig 1 shows the larger starter, type B; fig. 2 shows the connections when the motor is running.

BUSINESS NOTES.

Electrical Exhibition at Hounslow.—An electrical exhibition, arranged by the Heston and Isleworth U.D.C. Electricity Department, was opened at the Public Baths, Hounslow, on the 13th inst., the formal ceremony being performed by Sir James Clifton Robinson. In the course of his speech, Sir James referred to the proposal to construct a line from Southall to Twickenham, which would pass through Hounslow and Heston. The London United Co. had endeavoured on two occasions to obtain the necessary powers, but was not successful; the situation had now changed, and the people seemed to desire the tramways. Any concessions to be made, however, would have to come from the local authorities. He expressed his willingness to meet the municipalities concerned to discuss the matter.

In view of the large number of these local exhibitions that have been held, and of which notices have appeared in our columns, any lengthy description of this one is unnecessary. No time has been lost since Mr. P. E. Rycroft took over the management of the undertaking in arranging an exhibition. It was an excellent show, and, we believe, proved a popular attraction to local people. A large number of well-known firms were represented, including the Union Electric Co., Messrs. Dick, Kerr & Co., Krupka and Jacoby, Electromotors, Ltd, the B.T.-H. Co., Drake & Gorham, Veritys, Siemens Bros. & Co. Messrs. Park Bros., Ltd., of Ealing, exhibited a speciality that is intended to do away with all tee and angle pieces in steel conduit wiring, and also to effect a saving of wire over the ordinary method. Messrs. W. F. Dennis & Co., who had on exhibition a variety of "Kryptol" heating appliances, informed us that they are now acting as agents for the Kryptol material and appliances. The Exhibition closed on Wednesday last.

Bankruptcy Proceedings.—G. M. Sellick.—Under the failure of G. M. Sellick, electrical accessories manufacturer, 464, Romford Road, Forest Gate, the first meeting of the creditors was held on Wednesday last week at the London Bankruptcy Court before Mr. Walter Boyle, Assistant Official Receiver. The liabilities were returned at £439 11s. 8d. and the assets at £113 18s. It appeared that the debtor started business 12 years ago, and he attributed his failure to bad trade, family illness, want of capital, and competition of foreign trade. No offer being submitted, the case was left in the hands of the Official Receiver to be wound up in bankruptcy. The following are the principal creditors:—

Bullers, Ltd., London	£175
Edison & Swan Electric Light Co., London ..	39
Gilson & Co., London..	15
Hervé, L., London	78
Lion, S., Dalston	23
Macintire, J., & Co., Ltd., Burslem	22
Tomkin, W. A., Kingsland	22
Wright & Rowland, Birmingham	10
Taylor, Thorncliffe & Co., Ltd., Hanley.. ..	16

A. A. Adams.—The public examination was held on Wednesday at the London Bankruptcy Court before Mr. Registrar Giffard, of Alexander A. Adams, who applied to pass upon accounts showing total liabilities £7,505 9s. 6d. (unsecured £5,075 7s. 7d.), and net assets valued at £1,817 8s. 1d. In the course of his evidence the debtor stated, in reply to Mr. E. L. Hough, sen., that he started business in 1898 as a shipbroker and timber agent. He subsequently transferred his agencies to two companies of which he acted as managing director, his remuneration during the past three years having averaged about £1,100 per annum. He had also acted as director of other companies. In December, 1904, he commenced business at 86, Leadenhall Street, E.C., as dealer in and contracting for installing and maintaining electrical fittings and there traded, also at 23, Foubert's Place, Regent Street, W., under the style of the Electrical Insurance and Contracting Co., until some five months ago, when he abandoned the business, his stock-in-trade and effects at each of the addresses having been seized and sold under distraints for rent. Witness attributed his failure to loss, estimated at £2,400, on the electrical insurance and contracting business; to loss on a company; to depreciation in the value of his shareholding

ing, and to his household and personal expenses, including those incurred as a Parliamentary candidate at the last general election. The examination was concluded.

F. E. Williams & Co.—A meeting of the creditors of Frank Ernest Williams, trading as F. E. Williams & Co., electrical engineers, 328, Coventry Road, Birmingham, was held on Friday, and the Official Receiver was appointed trustee. The gross liabilities are £576, and the deficiency is £489. "Loss on a contract, heavy expenses, and depreciation in stock" are the causes of failure. Debtor commenced business in March, 1905, with a capital of £15. He lost £60 on a contract for electric switches owing to the rise of the price of material.

George Collier, gas and electrical engineer, 89, Long Acre, London.—A receiving order was made on February 11th on debtor's own petition. First meeting and public examination are to take place at Bankruptcy Buildings on February 28th and March 27th respectively.

Book Notices.—"Proceedings of the American Institute of Electrical Engineers," Vol. XXVI, No. 1, January, 1907. New York: The Institute. 50 c.

"Notes on Material, Construction and Design of Land Boilers." By Edward G. Hiller, chief engineer to the National Boiler and General Insurance Co., Ltd. Second edition. Manchester: The Company, 22, St. Ann's Square.

"Proceedings of the American Society of Mechanical Engineers," Vol. XXVIII, No. 6, February, 1907. Baltimore, Md.: The Society.

"Bulletin of the Imperial Institute." Vol. IV, No. 4, 1906. London: The Institute, or Eyre & Spottiswoode. 1s.

"La Construction des Machines Electriques." By Julien Dalémont. Paris: Ch. Béranger. 1907. 12.50 fr.

Colliery Contracts.—Messrs. F. Reid, Ferens & Co., of Newcastle and Sunderland, have recently secured several contracts in connection with collieries in Durham. These include extensive installations for lighting and power at Cramlington Colliery, Messrs. Pesse's Crook Colliery, and smaller work connected with the electrification of the Murton Colliery. At Brandon a contract has been arranged for the equipment of the street lighting by electricity, and the Consett Iron Co. have placed the work of placing an additional 50 ft. on to each of the two brick chimneys at their Chopwell colliery with Messrs. Ferens & Co.

Plant for Sale.—Sheffield Corporation Tramways Committee is offering certain plant for sale. For particulars see our advertisement columns.

Cryselco Works Extensions.—We are informed that in order to cope with the increasing demand for "Cryselco" lamps, Messrs. Cryselco, Ltd., have found it necessary to again add to their plant, and have placed an order with Crossley Bros., Ltd., for a 150-B.H.P. gas engine, and a 200-H.P. suction gas plant. This is in addition to the 100-H.P. Crossley engine and plant installed in 1905, their plant now totalling over 300 B.H.P.

Catalogues and Lists.—The Electrical Apparatus Co, Caxton House, Westminster.—16 pp. catalogue relating to enclosed and open fuses. "Electrostan" fuse wire and strip, "Koolark" enclosed fuses, switch fuses, magazine fuses, and magazine fuse carriers, &c., are illustrated and priced.

A.E.G. Foreign Department, Caxton House, Westminster.—Two new publications, one giving full particulars of prices, also illustrations of their brass-covered and iron-covered insulated conduit; the other showing various electric heating apparatus, including hot water cans, disk stoves, water boilers, soldering irons, melting pots, sealing-wax heaters, cigar lighters, curling iron-heaters, flat irons, electric stoves, heating panels, also heat regulators for tramcars and shop windows.

Endolithic Manufacturing Co., Ltd., 61½, Fore Street, E.C.—Postal card showing some of their name and instruction plates, which are used by many electrical firms.

Messrs. E. Brook, Ltd., Colne Road, Huddersfield.—New price list (No. 15) relating to their single-phase motors of from ¼ to 10 B.H.P. A brief specification and an instruction sheet with diagram of connections are given, also some figures relating to the horse-power taken by different kinds of machinery. All the firm's motors are made with sunk terminals in solid porcelain. The starters are entirely covered, so that it is impossible for anyone to come in contact with the live brass work or wires. The firm's out-put is now over 300 motors per annum, and their motors are stated to be working in fully 90 per cent. of the towns where single-phase working is the rule.

Messrs. Heap & Johnson, 28, Hatton Garden, E.C.—Illustrated leaflet showing their "National" self-lubricating carbon brushes, and giving a table of prices.

The Ebonestos Manufacturing Co., 22, Rosoman Street, E.C.—New lists giving illustrations and prices of their ebonestos moulded insulators, gas tube and conduit end bushes, a range of electrolier bushes, also brass and Whitworth thread bushes.

Messrs. R. H. Longbotham & Co., Ltd., 165, Queen Victoria Street, E.C., and Wakefield.—Small 20 pp. illustrated catalogue in which appear descriptions of their electric haulage gear fitted with flexible coupling and their improved friction clutch; also winding, hauling and capstan engines. The specialities here described were exhibited at the last Colliery Exhibition held at the Royal Agricultural Hall.

Sturmey Motors, Ltd., Lotts Works, 230—250, Widdrington Road, Coventry.—Circular describing and illustrating their Parsons light delivery vans which they are now placing on the market, and which they will be exhibiting at the forthcoming Commercial Vehicle Exhibition at Olympia. The makers claim to have provided a motor vehicle working satisfactorily upon ordinary paraffin fuels, not by the use of paraffin carburetters, but by a special type of engine construction.

Messrs. J. P. Hall & Co., Blackriding Iron Works, Werneth, Oldham.—New illustrated price list of squirrel cage and slip ring type induction motors for 1907. A description and general specification is followed by illustrations of both types of motor, complete and in parts, also a dimensional drawing and general tabulated details of poles, voltages, speeds, power factor, weights and prices.

Messrs. Dick, Kerr & Co., Ltd., Abchurch Yard, London, E.C.—New catalogue (20 pp. fine art paper), entitled "Industrial Applications of Electric Motors," giving a number of excellent half-tone views of plants supplied by them. These include electric pumping plant for Sydney water supply and sewage works, electrically-driven condensing plant, wood-working machinery, examples of motors bolted to ceilings or placed on brackets, motor driving carpet-cleaning machinery, punching and shearing and ripping machines, and live rolls, also controllers operating traction type motors.

The Key Engineering Co., Ltd., 4, Queen Victoria Street, E.C.—New catalogue consisting of a collection of leaflets caught together in a red-covered binder. These are all illustrated, and as a general rule state the prices of the things they describe. The ground covered is large, the specialities dealt with including switchgear, instruments, air compressors, gas engines (Ehrhardt & Sehmer), motor vehicles, fibre conduit, joint-boxes, water purifiers, Ross's self-lowering trolley arm, pumps and other things.

The Union Electric Co, Ltd., Park Street, Southwark, S.E.—List No. 1,005 of direct-current dynamos and motors of from ¼ to 2¼ B.H.P., stating outputs, speeds, and prices. Dimensional particulars appear on the reverse page. This list is supplementary to No. 1,004, which contained a range of motors from 3½ to 30 H.P.

Titan Packing Co., 2 and 3, Tower Royal, Cannon Street, E.C.—Circulars relating to their red and black "B.B." jointing, together with prices and directions for using same.

Messrs. Crompton & Co., Ltd., Salisbury House, E.C.—List No. P 27 (28 pages), describing their open type arc lamps. The construction of the four different patterns is stated. The descriptions of the various parts are accompanied with numerous illustrations, some showing the mechanism, others external views of lamps with different shaped globes, and some photographic views of public buildings where Crompton lamps are employed. Considerable space is devoted to accessories and spare parts, and prices are given.

The General Electric Co., Ltd., 71, Queen Victoria Street, E.C.—This company, as many of our readers are already aware, is organising a competition for the electrical trade in connection with its "Robertson" lamp department. We have received a copy of some illustrated literature relating to the competitions, giving particulars of the rules, prizes, and so on. The details of the competition we need not describe here, as they have been set out so fully "in another place" as members of the Lords and Commons say. A 28-page booklet relating to "Robertson" electric lamps has also just been issued. A variety of shapes for different classes of service are illustrated, and prices are shown at foot of each page. We have further received from the General Electric Co., Ltd., a large hanging wall calendar with monthly slips (showing dates very clearly figured) for the current year. The calendar will be of particular service to the trade, by reason of the fact that it gives, on the upper portion, photographs of 14 heads of departments, so that the user may know "Whom to ask for" when having occasion to call upon the G.E.C. Still another item received from this ever-restless publication department takes the form of a 12-page booklet relating to Witton arc lamp carbons of several brands and qualities. Prices are given, and some views of the carbon works also appear.

Dissolutions and Liquidations.—Colliery Power Supply Syndicate.—This company is winding up voluntarily, with Mr. W. W. Brierley, 24, Clegg Street, Oldham, as liquidator.

General International Wireless Telegraph and Telephone Co., Ltd.—This company is winding up, with Mr. W. H. Dove, 110, Cannon Street, E.C., as liquidator.

The Petroleum Engine Co., Ltd.—At an extraordinary general meeting to be held on February 26th, at Winchester House, a resolution to wind up the company voluntarily (with Mr. T. E. Shuttleworth, Royal Insurance Buildings, Church Street, Sheffield, as liquidator), will come up for confirmation.

McPhail & Simpson's Dry Steam Patents Co., Ltd.—A petition presented by the Birmingham District and Counties Banking Co., Ltd., for winding up this company is to be heard on February 26th before Mr. Justice Parker in London.

Simplex Steel Conduit Co., Ltd.—A meeting to hear an account of the winding up is to be held at 16, Waterloo Street, Birmingham. This, of course, is the old company.

Annual Dinner.—A dinner of the officials and foremen of the Carron Co. was held at the Plough Hotel, Stenhousemuir, on Friday evening, 8th inst. Those present included the manager, assistant manager, heads of departments, and all the various foremen employed at Carron and Mungal foundries, engineering works, the several collieries, and the Grangemouth and Bo'ness shipping staffs, who met under the chairmanship of the manager (Mr. Bamforth), supported by Mr. J. J. Maclaren, the chairman of the company, Mr. F. L. Burder and Mr. A. Mitchell-Dawson. The programme of toasts comprised only "The King, Queen and Royal Family," from the chair, and "Carron Co.", proposed by Mr. Peter Rae, one of the oldest foremen in the employment. A musical programme was provided which gave great satisfaction.

Trade Announcements.—The Henry Wells Oil Co. have removed to larger works, known as the Imperial Oil Works, Salford, Manchester, consequent upon the old premises being quite too small to allow the increase of business to be dealt with. The area covered by the new works is greater by about ten times than that of the old, and their equipment will, of course, be of the most modern description. The company have sent us a small office desk cabinet, consisting of a perpetual diary and office reminder arrangement on the card system, which we should imagine would be of considerable service to many business men.

Messrs. Ozonair, Ltd., 27, Chancery Lane, W.C., wish the trade to note that they have registered their telegraphic address as "Ozonair, London."

Messrs. I. Frankenburg & Sons, Ltd., Greengate Rubber and Cable Works, Salford, Manchester, have appointed Mr. J. Henry Phelps, of 11, Claude Place, Roath Park, Cardiff, as their agent for electric cables in the South Wales district.

Messrs H. W. Sambidge & Son, Ltd., opened their new showrooms in London on Monday last, 18th inst., where they have on view, among other things, a variety of their electric light fittings. Some examples of these were shown in our pages a few weeks ago.

Messrs. Jacomb Bros., of Wingfield Road, Stratford, having retired from business, the Electrical Canvassing Publications, written by Mr. C. Rockley, and published by them hitherto, will in future be procurable from J. Curwen & Sons, Ltd., 24, Berners Street, W.

The Anti-Attrition Metal Co., Ltd., have removed their offices to 50, Cannon Street, E.C., which is now the registered address of the company.

LIGHTING and POWER NOTES.

Acton.—As a result of negotiations between the U.D.C.'s electrical engineer and the engineer to the Metropolitan Electric Supply Co., the latter has agreed to recommend his company to consider a revision of the charges made to the Council.

Ayr.—The electric light supply in Ayr failed on Friday night last, through the flooding of a transformer station, by a burst water pipe. The officials repaired the pipe and pumped the water out of the station, but it was found impossible to light the town at night. Much public inconvenience was caused.

Bath.—The special committee appointed by the E.L. Committee to go into the offer made by a certain gentleman on behalf of a local power syndicate, and to report on the same, has concluded its labours. No actual recommendation was made in the report, but we gather that the disposal of the Corporation undertaking to private interests is thought to be best for the borough. The company seems to have offered very advantageous terms to the Corporation, and we may give further details on another occasion. The latest report states that the E.L. Committee, on Monday, unanimously recommended the Corporation to accept the purchase offer.

Beckenham.—The U.D.C. has decided to petition against the three big proposed Power Bills for London, and has appointed representatives to attend a meeting called by the Hornsey Borough Council, to consider a joint scheme of opposition by authorities affected.

Belfast.—After twice referring the question back to the E.L. Committee, without shaking the attitude of the latter, the Council on Tuesday last week accepted the Committee's recommendation, that the tender of Messrs. Willans & Robinson for two steam turbines, coupled to Brown-Boveri 1,000-kw. d.c. generators be accepted. The price quoted was £18,147 9s., of which £14,956 was for the turbo-generators, and £3,191 9s. for surface condensing plant. This was the highest price quoted for steam turbo-generators. Mr. McCowen recommended that if the Committee preferred reciprocating engines, Messrs. Dick, Kerr & Co.'s tender, with Bellis & Morcom engines, at £16,846, and condensing plant by Messrs. Mirrlees, Watson & Co., at about £2,900, be accepted. The fact that several British firms offered British turbines coupled to British dynamos, but that nevertheless the Committee passed over them all to accept the *highest* tender of the kind in order to send a large part of the work abroad is very significant, following upon the action of the Hull Committee, though the latter was certainly the worst. So long as foreign manufacturers can supply plant cheaper than our own, the principles of Free Trade impel us to purchase of them; but a deliberate discrimination against British plant, which involves the payment of higher prices than are demanded by first-class British makers, is unpatriotic, besides being contrary to the Free Trade maxim, "buy in the cheapest market." On the other hand, if a satisfactory machine cannot be got in this country, the Committee's action is justifiable; but is this really the case?

Continental Notes.—Italy.—In statistics recently published, it is shown that during 1906, at the Port of Genoa, 2,737,919 tons of coal were imported, whilst of railway-borne coal the total figure for 1906 was 1,239,450. This gives a consumption of nearly 11,000 tons per day; or, calculated at 4 lb. per unit, an amount capable of producing 250,000 kw. with a 100 per cent. load factor.

The City Council of Rome has had under consideration a project for a steam-driven central station and distributing scheme, estimated to cost, approximately, £145,000 sterling. This would provide plant of 3,000 kw. with an annual gross income of £20,000. The scheme has received the approval of the Council, and it is intended to proceed to put it into execution.

Germany.—A correspondent informs us that Messrs. Brown, Boveri & Co., of Mannheim, are at present engaged on the construction of a steam turbine of no less than 24,000 h.p. It is intended for the works of the Krupp Co. at Rheinhausen.

Croydon.—At the meeting of the B.C. on Monday last resolutions were submitted that the following Bills should be opposed by petition, counsel and witnesses: The Administrative County of London and District Electric Power, the L.C.C. Electric Supply, and the London and District Electric Supply. It was asked whether the L.C.C. had been approached to insert a clause in its Bill specially excluding Croydon. The clerk explained that last session, in regard to the Bill proposed then, the L.C.C. was asked to do that, but it stated definitely and distinctly that it was not prepared to listen to any proposal for a protective clause; if Croydon wanted it, it must be sought from Parliament. The resolutions were carried by 43 votes to 5.

Dundee.—Mr. J. F. C. Snell, consulting engineer, has now issued his recommendations to the Corporation. In a voluminous report Mr. Snell advises the expenditure of £93,358 in order to bring the electrical supply of the city into line with requirements. This expenditure provides for a new generating station with several sub-stations. The h.t. system of distribution is also suggested. In brief, Mr. Snell's recommendations show that:—Further generating plant is imperatively necessary; h.t. three-phase transmission must be adopted; a new power station must be proceeded with at once, and the Council should adopt a low, though financially sound, scale of charges to power users. They should encourage such a demand for the reason that the more varied the applications for electrical energy supplied from any station the more remunerative the general supply became. Mr. Snell will, in a further report, deal with the tramways and the assessment of the present undertaking. At present the community is face to face with several large schemes, one for a new town house, public hall, &c., costing £100,000, but inquiries by our correspondent elicited the information that the electric supply scheme would have precedence as being the most essential.

Ealing.—Last week the Electricity Committee reported to the Corporation that it had received from the Metropolitan Electric Supply Co. terms for a supply of electricity in bulk. The Committee recommended that the chairman and electrical engineer meet the company's officials and endeavour to obtain better terms, as it considered the offer in question too high. After some discussion, in which it was pointed out that it was necessary that the Corporation should take steps to increase the capacity of the undertaking, the Committee's recommendation was adopted.

Edmonton.—The Edmonton Board of Guardians has decided to accept an offer of the North Metropolitan Electrical Power Distribution Co. to provide an electric lighting installation at the Union Schools, with wiring and lamps and fittings, for a total of 113 points, at a cost of £170. An amendment to obtain other tenders was defeated, as also was another, that an electrical engineer should be employed to draw up specifications.

The District Council has consented to the North Metropolitan Electric Power Supply Co. erecting a sub-station on land belonging to the Council in the lower part of the district at a nominal rental of £1 per annum, and also a second one in the upper part of the district upon certain conditions.

Exeter.—Mr. H. R. Hooper held an inquiry at Exeter on the 15th inst. into applications made by the City Council for sanction to borrow sums of money in respect of various works. One application was in respect of a sum of £12,900 for E.L. purposes, including the execution of works in the Urban District of Heavitree. The clerk explained that the last loan for the E.L. undertaking was one of £68,385 in 1902. Of that sum the amount sanctioned for mains, transformers and meters was exhausted in December, 1904, since which £6,858 had been expended under similar heads. That was included in the £9,999 now asked for on loan for mains, transformers and meters, leaving £3,131 anticipated expenditure. Mr. Munro, the electrical engineer, said none of the cables laid 15 years ago had been taken up owing to deterioration. New works had led to the number of customers being increased by 50 per cent. during the past three years. The Inspector doubted very much whether a longer period than five years would be granted for the loan in respect of meters, having regard to past experience as to their durability in other places and the change being made in the meters now being placed upon the market. Mr. Hooper pointed out that there should be no necessity for excess expenditure in the future, because loans were issued in anticipation of expenditure, and when fresh expenditure was necessary a further loan should be applied for.

Hipperholme.—A sub-committee of the U.D.C. is in negotiation with the Electrical Distribution of Yorkshire, Ltd., for a supply of electricity in the district, and it has been recently stated that there is every prospect of a supply being available shortly.

Hull.—The E.L. Committee has adhered to its recommendation to accept the tender of the Lahmeyer Electrical Co. for the supply of a steam dynamo with Belliss engine at £3,915. The Council had referred the matter back in order to see if an

English firm could be awarded the contract, but only four members voted in favour of fresh tenders being advertised for.

Houghton-le-Spring.—The B. of G. has decided to obtain estimates for lighting the workhouse by electricity.

India.—The Madras E.L. and Power Co. is about to equip its generating station, and has placed contracts with Messrs. Crompton & Co. The generating plant will comprise three 500-KW. and two 250-KW. D.C. sets, and two 500-KW. and two 250-KW. three-phase A.C. sets. The general supply will be on the three-wire D.C. system, but it has been found necessary to provide a three-phase supply at 5,000 volts, stepped down to 225 and 450 volts as required. The engines will be of the low speed horizontal type with armatures mounted direct on the crankshaft. Water-tube boilers fitted with superheaters and chain-grate stokers, water-softening apparatus and motor-driven feed pumps, elevators and conveyors will be installed. The main sub-station, about four miles from the power house, will be supplied by means of a pair of three-core trunk mains, and will contain two 160-KW. motor-generators and two of 70 KW. (induction motors, generators to supply direct current at 450 volts); 30 miles of mains, 16 miles of low-tension feeders, and eight miles of three-core three-phase feeders will be required.

Kearsley.—The B. of T. has deferred the question of revoking the E.L. order of the U.D.C. for a time, pending negotiations for its transfer to the Lancashire Electric Power Co.

Kettering.—The U.D.C. has applied to the L.G.B. for a loan of £2,250 for the extension of the plant at the electricity works.

Leek.—An extension to the generating plant was started up last week, a number of visitors and members of the Council being present on the occasion. The plant consists of a 200-H.P. four-cylinder Campbell gas engine coupled to a generator supplied by the Industrial Engineering Co., of Hyde. The design of the new set is similar to that of the plant previously installed, which, we understand, has given every satisfaction since the works were inaugurated in 1904.

London.—WOOLWICH.—Before a meeting of the B.C. on the 14th inst. a report by Sir A. B. W. Kennedy upon the E.L. undertaking was presented. A very lengthy discussion took place. In the result, the report and recommendations were carried. We hope to publish some of the details contained in the report, next week.

SOUTHWARK.—The E.L. Committee has considered a report of the district auditor on the accounts of the electricity undertaking. Three points laid before the auditor in connection with the concern were (1) That it was much under-assessed; (2) That it did not bear the share of legal expenses which, as a trading concern, it should have done; (3) That a sufficient amount was not set aside for depreciation and obsolescence of machinery. The auditor declined to deal with objection 1. He expressed his agreement verbally with objection 2, but ruled against it on grounds of law. As to objection 3, he ruled that the sinking fund and repayment of loans were equivalent to a depreciation fund. In conclusion, the Committee expressed the opinion that it was desirable that in all municipal trading concerns there should be a separate and independent audit by a properly qualified commercial chartered accountant familiar with municipal concerns, who should be empowered to charge all expenditure under the proper headings. We agree with the Committee's observation. Sinking fund charges are not depreciation charges; a properly qualified accountant ought to know the difference between the terms, but many do not appear to do so.

STOKE NEWINGTON.—The contract with Messrs. W. T. Henley's Telegraph Works Co. for the supply and laying of mains provides for their free maintenance for 12 months, with an option to require the contractors to maintain for a further five years at 1½ per cent. per annum on the value of the cables supplied. Notice of intention to exercise the option is to be given.

HACKNEY.—In reference to the decision of the Joint Committee of the B.C. to dispense with Mr. Hammond's services as consulting electrical engineer, owing to his having accepted a retainer from the L.C.C. to act as expert adviser in connection with its Power Supply Bill, Mr. Hammond has written to the B.C., stating that he is willing to agree to his appointment being brought to an end, except as to the carrying out of the extensions at the generating station and the arc lighting at present in hand, and the winding up of the old contracts still outstanding. These conditions are to be considered by a Special Committee.

L.C.C. SUPPLY BILL.—At the recent annual meeting of the Electrical Section of the London Chamber of Commerce, after discussing the L.C.C. Electric Supply Bill, 1907, the Section resolved:—"That this Section, having considered the London County Council Electric Supply Bill, is of opinion that it is most undesirable, in the interests of the trading and commercial community (and calculated to destroy private enterprise), that the power to supply electricity in bulk should be in the hands of the London County Council."

L.C.C.—It was decided at Tuesday's meeting to lend £12,723 to the St. Pancras B.C. for mains, motor-converters and switchboards, house services and meters. A further sum of £800 was not sanctioned, as it was intended for the construction of foundations for a turbine which is being substituted for an engine of smaller capacity. The cost of the turbine was being defrayed out of the reserve fund, and the Finance Committee of the County Council had suggested that the foundations should also be paid for out of the same fund.

HAMMERSMITH.—Under powers conferred by the L.C.C. (General Powers) Act, 1906, the Electricity Committee has decided, subject to the usual sanction, to allow Messrs. Gwynnes, Ltd., to select certain plant they require for the purpose of taking a supply of electrical energy from the Corporation. Such machinery is to be paid for by the Council, subject to the borough electrical engineer being satisfied as to the quality and price of the plant; and Messrs. Gwynnes are to repay the Council by three equal annual payments, without interest, when the machines will become their property. It is anticipated that the total cost of the machinery will not exceed £1,000. Messrs. Gwynnes agree, subject to the adoption of the above conditions, to take a supply of alternating current for their test rooms at standard rates.

Norwich.—A loan of £25,000 is to be applied for by the T.C. for mains, services, meters, engine and dynamo, two boilers, steam pipes, mechanical stokers, feed pumps and a feeder booster.

Orrell.—The U.D.C. has applied to the B. of T. for an extension of time for carrying out the E.L. order.

Ossett.—The T.C. has decided to ask the National Electric Construction Co. if they are willing to reopen negotiations with a view to a lease or a transfer of the E.L. order

Portrush.—A deadlock has arisen in connection with the electric lighting scheme for this watering place. The U.D.C. entered into an agreement with a Belfast firm about a year ago for carrying out the installation, but subsequently a point was raised as to the legality of the agreement, owing to the fact that it had not been previously advertised. On the evening of the 11th inst. a special meeting was held to consider the question, but no definite decision was reached.

Radcliffe.—The U.D.C. has decided to supply large works with energy for power at 1d. per unit net, on a minimum quarterly consumption of 7,500 units.

Scunthorpe.—The B. of T. has extended the U.D.C.'s E.L. Order, 1903, for another year, with an intimation that no further extension will be allowed.

Weymouth.—A L.G.B. inquiry was recently made into an application of the T.C. to borrow £10,130 for extensions at the electricity works. The question of excess expenditure on previous loans again cropped up, and the inspector elicited the fact that the losses on the working of the undertaking had resulted in an overdraft at the bank. From the remarks made by the inspector at the inquiry, we should imagine that the prospects of the undertaking making a profit are somewhat remote.

Whitefield.—The U.D.C. has informed the ratepayers that the Lancashire Electric Power Co. is about to supply electricity for lighting and power purposes in the township.

Wisbech.—The Wisbech T.C. last week had before it a report by the Lighting Committee stating that, in company with a representative of the National Electric Construction Co., it had determined the positions of the street lamps, and recommended that 10 10-ampere arc lamps at £12 5s. per lamp be lighted from one hour after sunset to 11.30 p.m. the whole year, and after 11.30 the arc standards be lighted with two incandescent (tantalum) lamps, at £3 per pair, until one hour before sunrise; and that 15 pairs of tantalum lamps for all-night lighting throughout the year be supplied at a cost of £3 per pair. The cost was estimated at £198 per annum, against £147 for incandescent gas lamps. The report was referred back to the Committee for further consideration.

Wishaw.—The burgh has received sanction from the Secretary for Scotland to borrow a further sum of £15,000 for E.L. purposes. The undertaking has now been running about 16 months, and there are connected up 290 consumers, with a total of 14,000 8-C.P. lamps. The loan has been granted without any local inquiry. Plans and reports for the extensions, as well as for the original scheme, were drawn up by the burgh electrical engineer, Mr. E. F. Cox.

TRAMWAY and RAILWAY NOTES.

Barrhead.—It is announced that the Paisley and District Tramway Co. purpose applying to Parliament for power to extend their line from Barrhead to Thornliebank. The proposed route is three miles in length. The Glasgow Corporation has power to extend its line from Thornliebank to Spiers Bridge, part of the route which the Paisley Tramway Co. intend to traverse, though it has not yet exercised it.

Bolton.—Trials with a Darracq-Serpollet steam-driven 'bus of 30-40 H.P., capable of carrying 16 inside and 18 outside passengers, were made by the Tramways Committee recently. It is intended to establish another motor-'bus service between the town and the outside village of Darcy Lever.

Canada.—QUEBEC.—It is rumoured that for some time past the Canadian Pacific Railway has been endeavouring to purchase sufficient stock to give it control of the Quebec Railway, Light and Power Co., with the electric street-car system. The capital of the latter company amounts to $5,800,000, and if the

C.P. Railway secured the control, it is thought that important extensions would be made to develop the north shore of the St. Lawrence, where the railway company has large interests.

Continental Notes.—Berlin Tramways.—The extensive tramway system in the German capital is almost entirely in the hands of the Grand Berlin Tramways Co., which also holds the shares of the West Berlin suburban tramway, the Berlin-Charlottenburg tramway, and the South Berlin suburban tramway. Although the unfavourable weather prevailing during the summer of last year exercised a detrimental effect upon the traffic, the financial results for the whole of 1906 were satisfactory, and show an improvement over the preceding year. The accounts of the Berlin Co. indicate the following position for the past two years:—

	1906.	1905.
Ordinary share capital	£5,004,120	£5,004,120
Length, single track in miles	315	313
Number of motor-cars and trailers	2,442	2,431
Number of passengers carried	364,100,000	350,500,000
Gross receipts	£1,758,700	£1,714,450
Gross working expenses	£948,400	£937,400
Taxes paid to Berlin and local authorities ..	£123,903	£120,210
Share of Berlin Council in the net profits ..	£31,951	£18,889
Placed to renewal fund	£114,000	£101,250
Net profits	£495,100	£464,600
Dividend, per cent.	8	7½

In addition to a slight mortgage debt, the company has a bond issue, and the redemption of bonds in 1906 required £61,240 as compared with £59,100 in 1905, and the interest service absorbed £12,633, as against £14,764 in the previous year, whilst the sum of £32,850 was appropriated for the benevolent funds, as contrasted with £32,050 in 1905. The percentage of working expenses was 53·93 per cent., as compared with 54·68 per cent. in 1905. An interesting paragraph in the company's report refers to the accidents which took place in connection with the tramways during the year 1906. This may be summarised as follows:—

Slightly injured	1,748 persons
Severely injured	155 ,,
Killed	25 ,,
Total	1,928 persons

It was ascertained that out of the total number of accidents, the personal fault of the people concerned was responsible for 22 of the deaths, 131 of the severely injured, and 1,139 of the slightly injured persons. Two deaths, 17 severely injured, and 512 slightly injured were due to a foreign (external) cause; one, three and 77 respectively, were caused by illness or accident; and the cause in the remaining 24 cases was not ascertainable. The total mileage run during the year was 51,381,653 miles, as compared with 50,189,265 miles in 1905.

Holland.—Further schemes for the construction of electric railways and tramways *vice* electrification of existing lines are being discussed in the Dutch Press. Amongst the projects decided upon we note the following:—(1) Reconstruction of Groningen tramways, estimated to cost £65,000; (2) Construction of tramways at *(a)* Sloten to Amsterdam; *(b)* Maastricht to Vals, *viâ* the following places, Heer-Anebij, Gartier, Fer, Margraten and Witten (the concession for this work has been obtained by Messrs. Bulles, of Aix-la-Chappelle, and Messrs. Bos, of Rotterdam; *c*/Vostvoorde to Brielle with branches in the district; *(d)* Gand-Terneuren to Sas van Gent; *(e)* Weusel to Eindhoven *viâ* Acht; *(f)* Ridderkerk to Slik Kerveer and to a junction on the Rotterdam tramways. (3) Railways electrification: *(a)* Weert to Eindhoven; *(b)* Maastricht to Gulfen; *(c)* Maastricht to Vals (the Maastricht municipal authorities may give particulars of these lines); *(d)* Haarlem and Leyden districts (these lines are under the Hollandische Electrishe Spoorweg Maatschappij of Amsterdam); and *(e)* Amsterdam to Zaandam (by the Amsterdam and Nord Holland Electric Tramway Co., of Amsterdam).

Germany.—Electric traction is, it is announced, to be adopted on the railway between Kiel and Hamburg.

Turkey.—The horse tramways in Salonica are to be converted to electric traction.

Switzerland.—The Oerlikon and the Siemens-Schuckert Companies have proposed to the Federal Swiss Railway the introduction of electric traction on the Zurich, Lucerne and St. Gothard railway, a portion of which can be put in hand, at the outset, experimentally. The preparation of plans and work necessary for such conversion should be undertaken in such a manner as to complete the work by the time that the St. Gothard line becomes federal property in 1909. The views of the directors of the Federal railways seems to indicate that they will accept the proposal as regards the 58 km. of line between Zurich and Lucerne.

Cavehill.—The Cavehill and Whitewell Tramways Co. is applying for powers to enable it to run over the Belfast Corporation system. The latter is opposing the Bill, but we learn that it is willing to meet the company; it is even suggested that the Corporation would purchase the company's system.

Dudley.—The T.C. met on Friday last for the purpose of considering its position in regard to the tramways. The difference between the prices fixed by the arbitrator and the Court of Appeal is £16,000 in favour of the company. The Council, on the proposition of the Mayor, passed a resolution that the case be carried to the House of Lords.

Glasgow.—The T.C. has agreed to the proposal to extend the generating plant at a cost of about £55,000. It was stated that the adoption of this recommendation did not in any way interfere with the notice of motion recently given, that the Corporation electricity supply works be controlled under one department.

Leicestershire.—The County Council has assented to an application to the Light Railway Commissioners for a three years' extension of time for the completion of the railways under the Leicester and District Order, 1904, which expires in 1909.

London.—Islington.—The B.C. at its meeting on Friday unanimously passed a resolution declining to consent to the adoption of the overhead system of electric traction in any part of the borough.

Baker Street and Waterloo Railway.—It was reported last week that one of the motor-cars took fire, and that considerable alarm was caused by the tunnel becoming thick with smoke. Passengers had to leave the train and walk back to the nearest station. On the same day a train on the Metropolitan District Railway took fire and traffic was held up for about 40 minutes.

Manchester and Altrincham.—The tramway extension from West Timperley to Altrincham is making rapid progress. Lines are now laid as far as Barrington Road, in the Altrincham direction. It is hoped that a through service of cars will be running between Manchester and Altrincham shortly after Easter, as this will be the most popular route for holiday traffic out of the city. A branch line from Ashfield Road (on the main highway) to Sale Bridge is completed, and cars are expected to be running over it in two or three weeks.

Manchester and Ashton-under-Lyne.—Monday last saw the beginning of a regular tramcar service to and from Ashton and Manchester, *viâ* Openshaw. The cars of the city and borough run alternately on this route.

Manchester and Salford.—An arrangement for intercommunication between Manchester and Salford has been under the consideration of the tramway authorities of the city and borough for some weeks past. The chairman of the Manchester Tramways Committee (Mr. Alderman Wainwright) and the chairman of the Salford Committee (Mr. Alderman Linsley) had a conference a few days ago, at which the Mayors of Manchester and Salford were present. The matter was discussed in all its bearings, and in the end it was decided to refer it to the tramway managers, with a request that they should draft a report specifying the best through routes to be connected, with a view to the inter-running of cars. There will be another consultation, probably at the invitation of the Mayor of Salford, at the Salford Town Hall.

New York.—On the 16th inst. an electric train on the New York Central, when travelling at a high rate of speed, left the track, with the result that 20 or more persons were killed, and a large number injured. So far as we are able to gather, the accident is in no way attributed to the method of traction, but it is surmised, the train was running round a curve at too high a speed. We gather from the *Daily Telegraph* correspondent that electric trains have been running over this section (Harlem) for some weeks, and that on the day of the accident the entire electric system of the N.Y.C. was to have been inaugurated.

Perth.—Mr. J. Lambert occupies the position of burgh electrical engineer and tramways manager for the Corporation. We gather that the question of placing the tramways under separate management has been under discussion.

Rochester.—We understand that the Corporation has decided to lay down extensions to its tramways (leased to the Chatham and District Light Railway), and that its engineer has been instructed to draw up detailed plans of lines through the High Street, over the Medway Bridge, and into Strood and Frinsbury, and the northern parts of the town.

Victoria.—The Premier, the Hon. Thomas Bent, is considering during the recess, the electrification of the railway from Melbourne to St. Kilda, and also the proposal to electrify the whole of the suburban railways. This large scheme would involve 40 miles of railways, and a cost of about 2½ million sterling. It is anticipated that the smaller scheme can be completed for £30,000.

Wigan.—A collision occurred recently on the Corporation tramways, which was attributed to the greasy state of the rails. Several passengers and a motorman had to be medically attended.

York.—The T.C. on the 13th inst. adopted a report of the Tramways Committee recommending the Council not to withdraw its memorial against the York and District Tramways Bill. It was stated that there were many objections to the Bill as deposited; the plans in many respects did not comply with the requirements of the L.G.B. with regard to double tracks in streets, and, if the Council allowed the tramways to be laid down as proposed, the city would be involved in enormous capital expenditure for street widening.

At a meeting of the T.C. on the 18th inst., the provisional agreement with the York Tramways Co. for the purchase of the undertaking for £11,000, the purchase money to be paid on July 18, 1909, or within three months of the Council obtaining powers to work the tramways, or whichever event should first happen, was agreed to by a large majority.

TELEGRAPH and TELEPHONE NOTES.

Italy.—The Italian Minister of Posts and Telegraphs proposes to expend about £482,558 on telegraph materials, and to establish wireless telegraphic communication between the mainland and Sicily and Sardinia. Provision is also made for the expenditure of about £328,000 on the extension of the telephone service.—*Board of Trade Journal.*

On the 20th ult. the new Government trunk telephone lines were placed in public service between Brindisi and Taranto.

New Cable.—The annual report of the Mackay companies announces that a new cable will be laid between New York and Havana.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	..
Paramaribo-Cayenne	Nov. 27, 1906	..
Cayenne-Pinheiro	Aug. 13, 1902	..
St. Lucia-Martinique	May 7, 1902	..
Dominica-Martinique	May 7, 1902	..
Curacao-Coro / Curacao-La Guayra / Curacao-Maracaibo	Closed.. Jan. 12, 1906	..
Reissa-Issa and Reissa-Yemani (Yemen)	Oct. 22, 1902	..
Tarifa-Tangier	Jan. 18, 1904	..
Port Arthur-Chifu (Closed)	Mar. 9, 1904	..
Garachico-Santa Cruz	July 12, 1906	..
Las Palmas-Arecife	Aug. 18, 1906	..
Guantanamo-Mole St. Nicholas	Nov. 22, 1906	..
Fao-Bushire	Dec. 4, 1906	..
Martinique-Paramaribo	Dec. 17, 1906	..
New Brunswick-Prince Edward Island	Jan. 9, 1907	..
Odessa-Kilios	Feb. 9, 1907	..
Communication with Punta Arenas (Chili), *via* Galveston	Feb. 6, 1907	Feb. 12
Tenedos-Lemnos	Feb. 7, 1907	Feb. 18
Tenedos-Chio	Feb. 13, 1907	..
Landlines.		
Puerto-Barrios	Aug. 28, 1902	..
Bagdad-Bassorah	Feb. 12, 1907	Feb. 13
Teheran-Bushire	Feb 15, 1907	..
Bagdad-Pao	Feb. 15, 1907	Feb. 16

Wireless Telegraphy.—According to Reuter, the French Government is about to institute a consulting commission for the organisation of wireless telegraphy. Exceptionally powerful stations will be established at Ushant, Marseilles, Algiers, Toulon, Bizerta and Oran. Ordinary stations will be erected at Dunkirk, Cherbourg, Brest, Lorient, Rochefort, Ajaccio, Boulogne, Havre, St. Nazaire, La Coubre, Nice and Cape Corse.

The Italian Minister of Posts and Telegraphs has determined to put wireless telegraphy in service between the principal cities, namely, Milan, Turin, Genoa, Boulogne, Florence, Naples, Palermo and Cagliari, with the most important centre at Rome. The estimated cost is 30,000 lire per station.

The telephone administration in Vienna having increased the subscription from 200 to 500 crowns, the subscribers have formed themselves into a committee of defence. They will oppose the administration by refusing permission to attach wires to the walls or the roofs of houses, and by requesting the managers of public institutions to cease subscribing to the telephone service until the authorities lower the subscription to its original figure.

CONTRACTORS' COLUMN.

Openings for New Business.

BACUP.	Two cotton spinning mills on Rockliffe estate, Bacup, to hold 60,000 spindles (Ross Spinning Co.). Messrs. Stott & Sons, of Manchester, architects and consulting engineers.
BARNSLEY.	Secondary school (£14,750). Buckland, Haywood, Farmer and Ashford, Easy Row, Birmingham, architects.
BARNSLEY.	New Empire Palace Theatre.
BIRKDALE.	New Roman Catholic Church (Sacred Heart). Vicar, Father O'Reilly, Ainsdale.
BIRKENHEAD.	Public library, Market Place South. Town clerk; architect not yet chosen.
BIRMINGHAM. (Bordesley Green).	Fire station. City Surveyor.
BIRMINGHAM.	Extension to Council House, Congreve Street, Edmund Street. H. V. Ashley and Winton Newman, architects, 10, Gray's Inn Road, London.
BIRMINGHAM.	Shops, offices, &c., Cannon Street and Needless Alley. F. W. Lloyd, 50, New Street, architect.
BIRMINGHAM.	Bakery, Great Brook Street and Belmont Row. R. Worcester, 1, Balloon Street, Manchester, architect.
BIRMINGHAM.	Chapel, Ladypool Road. W. Hale & Son, architects, Colmore Row.
BIRMINGHAM.	Institute, Gymnasium, Lecture Hall, &c., Coventry Road. Ingall & Son, architects, Temple Row West.
BIRMINGHAM.	Factory, Legge Lane. W. G. Payton, architect, 84, Colmore Row.
BIRMINGHAM. (Harborne).	Fire station. City Surveyor.
BRADFORD.	Reinstatement of spinning mill in Filey Street, Hammerton Street, after fire. Walker & Collinson, Cheapside Chambers, Bradford.
BRADFORD.	St. Joseph's new Roman Catholic College. J. Simpson, architect, Cunliffe Terrace, Bradford.
BRISTOL.	Large new building for Baker, Baker & Co. (drapers and Manchester warehousemen), in Mary-le-port Street and Bridge Street. W. King & Son, 3, Vauxhall Bridge Road, Westminster, S.W., contractors.
BRISTOL.	Extension of the East Street branch of the W. D. and H. O. Wills tobacco factory. Frank Wills, Stephen Street, Bristol, architect.
BRISTOL.	Additional section to J. S. Fry & Sons, cocoa and chocolate factory. Messrs. Fry carry out their own building schemes.
CARDIFF.	Joint stores, public works and cleansing depôts in Trade Street, for the Corporation. W. Harpur, city engineer.
CHESHIRE.	New elementary school at Mottram Street. Andrew J. Cubbon, architect, 4, Chapel Walks, Manchester.
CROYDON.	Addition to brewery. Berney & Son, 104, George Street, Croydon.
CROYDON.	Motor garage. E. J. Saunders, 48, Wellesley Road, Croydon, builder.
DERBY.	New works to be erected for Messrs. Aiton & Co., engineers, Willesden, who are removing to Derby. Works to employ 200 men.
DERBY.	Schools (Nottingham Road). Messrs. Pegg & Bailey, builders.
DERBY.	Schools (Clarence Road). Messrs. R. Weston & Son, builders.
DERBY.	Shop, Midland Drapery Co.'s extensions, St. Peter's Street. Messrs. Weston & Son, builders.
DUNDEE.	New town house and offices (£60,000 to £140,000), for the T.C. Suggested.
DUNDEE.	Works extensions for Grant & Baxter, Constitution Street.
DUNDEE.	Alterations to workshop and stores for Earl of Home, Douglas Street.
DUNDEE.	Alterations to shop and hotel in Reform Street for Thomas M'Nair.
EXETER.	Additional building, West of England Deaf and Dumb Institution (£4,000). Mr. J. W. Jerman, F.R.I.B.A., Exeter, architect.
FAILSWORTH (Lancs.).	Public library to be erected. H. C. Broome, Clerk to the U.D.C.
GLASGOW.	New motor works. Kennedy Motor Car Co., Cathcart.
GLASGOW.	New motor garage. James Miller, architect.
GLASGOW.	New Parish Council Chambers (Cathcart), Henry Hunter, 162, Prospect Hill Road, Cathcart.
HARROGATE.	Golf Club House. Richard Crosland, architect, 10, James Street, Harrogate.
HEAGE (Derbyshire).	Extension of the Heage Endowed Council school, for the Derbyshire Education Committee. G. H. Widdows, architect, County Education Offices, St. Mary's Gate, Derby.
HOUGHTON (Co. Durham).	Joint smallpox hospital (£2,019). R. D. Harrison, Houghton, builder.
HULL.	Shops and billiard saloon to be built by the Corporation.
HULL.	Custom offices, waiting rooms, &c. R. F. Dunnell, secretary, North-Eastern Railway, York.
IRELAND.	The local authorities of the Counties of Limerick, Kerry, and Clare are likely to fall into line for the erection of a joint consumptive sanatorium, which will be electrically lighted.
KEIGHLEY.	Warehouse at Holme Mill. J. Haggas & Sons, architects, North Street.
KINGSTON.	Second swimming bath for the T.C. Borough Surveyor.
LEEDS.	Shops and hotel premises. Thos. Winn & Sons, architects, Carlton Chambers, 84, Albion Street, Leeds.
LEEDS.	Shops and hotel in Commercial Street. T. Winns and Sons, architects, Carlton Chambers, 84, Albion Street, Leeds.
LEEDS (Briggate).	Conversion of Messrs. Broadbent's premises into an exchange.
LEEDS.	New shops and hotel in Commercial Street; also re-erection of Mitre Hotel, in Brudenell Road. T. Winn & Sons, architects, 84, Albion Street
LICHFIELD.	Workhouse, infirm and children's wards (£5,118). R. Kershaw, Princess Street, Burton-on-Trent, builder.
LONDON.	New Technical Institute for South-East London, for the Buildings Sub-Committee of the L.C.C. Education Committee.
LONDON (Chiswick).	Girls' secondary school (£12,000), for the Chiswick Education Committee. Proposed.
LONDON (Great Portland St.).	New concert hall (£100,000). Building to be ready by September.
LONDON (Acton, W.).	Four large private residences in Acacia Road, Cumberland Park. Electricity intended. G. Smith & Sons, builders, 23, Glebe Street, Barnes, S.W.
LONDON (Acton Green, W.).	New church of St. Peter's. Rev. H. G. Houseman at head of Building Committee.
LONDON (Lewisham, S.E.).	Branch library in Torridon Road. Patman and Fotheringham, 100-2, Theobald's Road, W.C., builders.
LONDON (Battersea).	Church in Altenburgh Gardens. Kelly & Dickie, 496, Oxford Street, W., architects.
LONDON (Tooting Bec).	New blocks to asylum for Metropolitan Asylums Board.
LONDON (Hornsey Road, N.).	Mission Hall. Smee & Houchin, architects, 85, Fleet Street.
LONDON (Kensington).	Twenty-four houses in St. Quintin's Park. Trant, Brown & Humphreys, 28, Victoria Street, S.W., civil engineers.
LONDON (Kensington).	Buildings in Gloucester Road. P. Hoffmann, 150, Palmerston House, Bishopsgate Street, E.C., architect.
LONDON.	Additions, &c., to West Ham and East London Hospital, H. P. Adams, architect, 28, Woburn Place, Russell Square, W.C.
MARGATE.	Additional block to East Cliff House for Metropolitan Asylums Board.
MIDDLETON (Lancashire).	The "Times No. 2" new cotton mill, to contain 174,000 spindles. Architects, Potts, Son and Hennings, Oldham and Manchester. Contractor, Johnston Partington, Middleton Junction.
NEWCASTLE-ON-TYNE.	Extensions for Blaydon District Industrial and Provident Society (Chopwell branch). F. M. Dryden, architect, 6, Market Street, Newcastle-on-Tyne.
NEWCASTLE-ON-TYNE.	Slaughter houses (£7,558). J. and G. Douglas, Northumberland Road, Newcastle, builders.
NORWICH.	Mansion, Cringleford, Norwich. Messrs. Postle and Webster, architects, Redwell Street and Bank Plain, Norwich.
PONTEFRACT.	Drill Hall. Garside & Pennington, architects, Pontefract.

PRENTON (Cheshire).	New Congregational Church. Pastor, the Rev. J. A. Middleton.
RADCLIFFE. (Lancs.).	New spinning mill to be erected. Wilton Spinning Co., Ltd. (owners).
ROCHESTER (Frindsbury)	Baptist Church, Maidstone Road. Builder. Mr. Geo. Gates, Frindsbury, and architect, Mr. Geo. E. Bond, King Edward Road, Rochester.
ST. ALBANS.	Grammar school. P. C. Blow, architect, St. Albans.
ST. AUSTELL.	New Secondary School in Tregonessy Road (£5,000). Secretary for Technical Education, Mr. Gill.
SAXMUNDHAM.	Additions to Carlton Hall (£8,692). Sendall & Co., Ltd., builders, Cambridge.
SELBY.	New ward at Brooke Dispensary and Cottage Hospital. (Miss Standering, donor, Andus Street, Selby.)
SHAW (Near Oldham).	New cotton mill, owned by a limited company, to be called the Rutland Mill. Foundations now being dug. Architect, Mr. F. W. Dixon (Mayor of Southport).
SHILDON (Co. Durham).	Council School. County architect, Shire Hall, Durham.
SOUTHEND.	New opera house at Westcliff (£20,000).
SOUTHPORT.	New Council School. Competitive plans are now being invited by the Southport Education Committee.
SURREY.	County smallpox hospital (£10,987). Hunt & Sons, Station Works, High Wycombe, builders.
TRANMERE (Birkenhead).	Extension of workhouse. E. Kirby, architect, 5, Cook Street, Liverpool.
WARRINGTON.	Council schools (£8,062). Harry Fairclough, Mersey House, Warrington, builder.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdeen.—March 19th. Surface condenser, with air pump, oil separator, &c., for the Corporation Electricity Department. See "Official Notices" to-day.

Austria.—Bosnia-Herzegovina.—July 27th. The Government construction department at Serajevo invites tenders by July 27th for five to eight motor-cars for the electric tramways of that town.

Battersea.—March 5th. Various materials for the electricity department. See "Official Notices" February 15th.

Belgium.—March 30th. The municipal authorities of Liége invite tenders for a central station. For further particulars see our issue of January 25th.

Copenhagen.—March 18th. Two steam turbine alternators (three-phase), 2,500 kw. each, for the Corporation. See "Official Notices" January 25th.

Denmark.—March 18th. The municipal authorities of Copenhagen are inviting tenders for the supply of two sets of steam turbines and three-phase alternators, each of 2,500 kw. capacity, for the central electric lighting station.

Dublin.—February 28th. Steam turbine alternating-current set (1,500 or 1,000 kw.) for Pigeon House generating station. See "Official Notices" February 15th.

Eccles.—March 9th. Lancashire boiler, superheater, economiser, 100-kw. engines, and d.c. dynamos for the Corporation. See "Official Notices" to-day.

Fulham.—February 27th. General and electrical stores for the B.C. See "Official Notices" February 15th.

Glasgow.—March 25th. Steam turbo-alternators with condensing plant for the Pinkston generating station. See "Official Notices" to-day.

Gravesend.—March 2nd. Coal, engine room stores, carbons, meters and indicators, &c., for the Corporation. See "Official Notices" February 15th.

Handsworth.—March 7th. Switchboard extension and equaliser booster for the U.D.C. See "Official Notices" February 15th.

Hanley.—Supply of slack to the Electricity Committee. See "Official Notices" to-day.

Hoylake.—March 7th. Tenders for 63-cell battery for the U.D.C. See "Official Notices" to-day.

Iceland.—March 31st. The Reykjavik Town Council is open to give a concession for the supply of electrical energy and gas. See "Official Notices" December 7th.

Ilford.—February 26th. Feeder booster and switchboard for the U.D.C. See "Official Notices" February 8th.

Ilford.—February 26th. Stores for the U.D.C. electricity and tramway departments. See "Official Notices" February 15th.

Marylebone.—March 13th. Stores for the electricity department. See "Official Notices" February 15th.

Marylebone.—March 13th. House meters for one year, for the Electricity Department. See "Official Notices" to-day.

New Zealand.—The Auckland Corporation requires tenders for supply, delivery and installation of underground and overhead cables for electric lighting. For particulars apply to Alfred Sexton, acting town clerk.

Perth (Western Australia).—March 25th. Lead-covered paper-insulated telephone cable. See our issue of February 1st.

Sheffield.—March 4th. Water storage reservoir, valves, screens, &c., for the City Council. See "Official Notices" February 15th.

Sheffield.—March 25th. Machines for regulating the power factor of an a.c. supply system for the electric supply department. See "Official Notices" February 15th.

South Australia.—March 6th. The Postmaster-General requires tenders for telephone and telegraph material. For particulars see our issue of January 18th.

Spain.—March 14th. The Director-General for Posts and Telegraphs requires tenders for 60,000 porcelain insulators (Spanish telegraph type No. 2) by March 14th, 11 a.m. A deposit of 5 per cent. is required. Tenders to Direccion General de Correos y Telegraphos, Carretas 10, Madrid.

Spain.—March 14th. The Drainage Commission of Santa Maria de Belsué, at Huesca, requires tenders for plant and material for the construction of a water-power driven electrical installation, and for the transmission of power over its drainage area. Particulars may be obtained from, and tenders addressed to, the Junta, &c., at the above place, by March 14th.

Spain.—March 31st. The Harbour Works authorities at Huelva are inviting tenders for the establishment of a central station for the supply of the necessary electrical energy required for lighting and power purposes at the harbour.

Spain.—Tenders have just been invited by the municipal authorities of Olmedo (province of Valladolid) for the concession for the electric lighting of the town.

Stockport.—February 25th. Five double-deck top-covered cars, single-truck type, with electrical equipments, for the Corporation. Particulars from J. Atkinson, borough surveyor.

Sunderland.—March 1st. (*a*) Buildings and shaft; (*b*) three-phase turbo-generator, condensing plant, cooling towers; (*c*) water-tube boilers, economisers, &c., for the Corporation. See "Official Notices" February 8th.

Sunderland.—March 7th. Tramway wheel lathe for the Corporation. See "Official Notices" to-day.

Swindon.—March 11th. Materials for the electricity and tramway department for one year. See "Official Notices" to-day.

Sydney (N.S.W.).—March 6th. Tenders for the supply of 7½ tons of hard-drawn copper wire, 200 lb. per mile. For further details see our issue of January 25th.

War Office.—February 25th. The Secretary for War invites tenders for the purchase of Lancashire boilers and condensing engine at Waltham Abbey.

CLOSED.

Acton.—Tenders for the supply of materials, &c., for the year ending March 31st, 1908, have been accepted from:—

The General Electric Co., Ltd. (steel tubing).
The Reason Manufacturing Co., Ltd. (prepayment meters).
The British Insulated & Helsby Cables, Ltd. (cable compound).
W. Lucy & Co., Ltd. (house fuse boxes).
Johnson & Phillips, Ltd. (house service boxes).
St. Helens Cable Co. (cable).

Belfast.—Messrs. Babcock & Wilcox have secured the contract for the new boilers for the Corporation electricity works, at £7,126. Six firms tendered.

Bengal-Nagpur Railway.—Messrs. D. Santoni & Co. (1906), Ltd., have just secured, in open competition, the contract for the supply of 48 "Santoni" flame lamps, and eight open type arc lamps for the above railway, with poles, insulators, &c., for £660.

Bridlington.—The directors of the New Spa and Gardens Co., Ltd., have received the following tenders for the wiring of the New Theatre and Opera House, on the Spa:—

W. H. Archer, Scarborough	£357
Vaughan & Cook, London	497
J. D. Morton, Mirfield	324
Walker & Hulton, Scarborough	268
C. Jubb & Co., Batley	315
Bold Bros., Lindley	250
R. Falshaw, Harrogate	576
Wallis & Watson, Leeds	373
G. Newby, Harrogate	225
Chas. Pullen, Bradford	285
H. Hyde, Hull	267
A. Innes, Leeds	335
R. Winder, Leeds	262
A. C. Dickens & Co., Northampton and Grimsby (accepted)	216
York Electrical Co., York	320
Dixon & Sons, Leeds	283
Bradford Electrical Co., Bradford	234
J. P. Beckett & Co., Grimsby	255
E. M. Parsons, Hull	418

Brighton and Birkenhead.—The Corporations of both of these cities have placed a year's contract for carbons with Messrs. Geipel & Lange.

Glasgow.—Messrs. Claud Hamilton, Ltd., have secured the contract for the electric lighting installation of the King's new yacht *Alexandra*, at present under construction on the Clyde.

Greenock.—Electric lighting of the new Gartsburn school, the Alliance Electrical Co., Ltd., Glasgow.

London.—Islington.—The B.C. received the following tenders for an electrically-driven winch:—

Carl Flohr	£175
Monté Callow & Co.	165
Scott & Mountain, Ltd.	156
Applebys, Ltd.	148
" "	110
Pickerings, Ltd.	148
John Hitchen & Sons	133
Stothert & Pitt	130
Clarke, Chapman & Co.	130
Heenan & Froude, Ltd.	121
The Keighley Electrical Engineering Co.	112
Wild & Co.	91
Adamson, Ramsbottam & Co.	90
Laidlaw, Laidler & Co.	80
Chatteris Engineering Co.	77
Crompton & Co.	76
T. Broadbent & Sons (accepted)	62

The Lighting Committee has been authorised to arrange with the British Insulated & Helsby Cables, Ltd., for an extension of their existing contract for the supply of cable for a further period not exceeding 12 months. It was not considered desirable to advertise for tenders owing to the high price of copper at present.

L.C.C.—The Highways Committee of the L.C.C. has received the undernoted tenders for the supply of induction motor-generators for the tramway sub-stations at Shoreditch, Islington, Holloway, Stockwell and Tooting:—

General Electric Co. (recommended)	£23,352
J. H. Holmes & Co.	24,973
British Electric Plant Co.	25,178
Electric Construction Co.	26,306
British Westinghouse Co.	26,990
British Thomson-Houston Co.	28,991
Siemens Bros.' Dynamo Works	30,402
Mather & Platt	30,945
Dick, Kerr & Co.	31,162
Johnson & Phillips	34,191

Sheffield.—The T.C. has accepted the tender of Messrs. Edgar Allen & Co., Ltd., for the supply of double junctions for the tramways.

Tottenham.—The U.D.C. received the following tenders for the wiring of the extension of the central library:—

Young & Co.	£279
Murrell Bros.	97
J. H. Golding	86
Edmundson's Electricity Corporation, Ltd.	94
L. G. Tate	139
Berry, Skinner & Co.	98
" " (alternative, own specification)	69
Mossop & Co.	108
Keen & Co., Kilburn, N.W. (accepted)	60

Yarmouth.—The T.C. has accepted the following tenders:—

Mr. B. G. Beach.—Extensions to car-shed, £2,155.
Walter Scott, Ltd.—150 tons of steel rails, £6 10s. per ton, and 75 tons, at £8.
British Electric Equipment Co., Ltd.—Poles and overhead equipment, £1,612.
Brush Electrical Engineering Co., Ltd.—Four cars with garden seats and opening sashes, £520 each.
Millars, Karri & Jarrah Co., Ltd.—Paving blocks, £9 5s. 5d. per 1,000.

The Interesting L.G.B.—In the House of Commons on Monday, in reply to a question by Mr. Bottomley, Mr. John Burns said that the Local Government Board had never met. (Laughter.) The Board comprised himself, the Lord President of the Council, the five principal Secretaries of State, the Lord Privy Seal and the Chancellor of the Exchequer.

Mr. Bottomley: Will the right hon. gentleman take into consideration the necessity of at once convening a meeting of the Board?

Mr. Burns: Not if I can possibly avoid it. (Loud laughter.)

FORTHCOMING EVENTS.

To-day's Events (Friday, February 22nd).—At 3.30 p.m. Institution of Electrical Engineers (London Students). Visit to the B. of T. Laboratory, Whitehall.

At 5 p.m. Physical Society. Prof. Lyle on "Transformer Indicator diagrams"; Prof. Bragg on "Ionisation of Gases by α Particles of Radium"; Mr. B. Roberts, "A Micromanometer."

Institution of Electrical Engineers (Manchester). Annual dinner.

At 7 p.m. Armstrong College Engineering Society. Mr. O. J. Williams on "Insulation applied to Electrical Engineering."

At 8 p.m. Electro-Harmonic Society. Ladies' Night. Concert at the Holborn Restaurant. See "Notes" to-day.

At 8 p.m. Institution of Civil Engineers (Students). Mr. F. E. Walker on "Impurities in Boiler Feed-Water; their Nature, Effect, and Elimination."

At 9 p.m. Royal Institution. Mr. D. Clerk on "Flame in Gas and Petrol Motors."

Saturday, February 23rd.—At 3 p.m. Royal Institution. Prof. J. J. Thomson on "Röntgen, Cathode and Positive Rays." (Lecture II.)

At 3 p.m. Junior Institution of Engineers. Visit to Rotherhithe Tunnel Works.

Northampton Institute Engineering Society. Visit to the Walthamstow U.D.C. generating station.

Association of Engineers-in-Charge. Dance.

Tuesday, February 26th.—At 8 p.m. Institution of Civil Engineers. Mr. D. Clerk "On the Limits of Thermal Efficiency in Internal-Combustion Motors."

Monday, February 25th.—At 8 p.m. Institution of Electrical Engineers (Newcastle). Mr. H. Henderson on "Train Lighting."

Wednesday, February 27th.—At 7.30 p.m. Institution of Electrical Engineers (London Students). Mr. C. M. Dowse on "Train Lighting."

Thursday, February 28th.—At 7.30 p.m. Institution of Electrical Engineers (London Students). Dinner at Holborn Restaurant.

Friday, March 1st.—At 3.30 p.m. Institution of Electrical Engineers (London Students). Visit to the Board of Trade Laboratory, Whitehall.

At 8 p.m. Institution of Mechanical Engineers. Discussion (continued) on the Report of the Alloys Research Committee.

Saturday, March 2nd.—At 3 p.m. Royal Institution. Prof. J. J. Thomson on "Röntgen, Cathode and Positive Rays." (Lecture III.)

Institution of Electrical Engineers (Manchester Students). Visit to the Salford Corporation generating station, Pendleton.

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

The following orders are issued:—

Monday, February 25th.—"A" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.

Tuesday, February 26th.—"B" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.

Wednesday, February 27th.—"A" Badge examination.

Thursday, February 28th.—"C" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.

Friday, March 1st.—"D" Company, recruits' infantry drill, 6 p.m., techniacl instruction, 7 p.m.

Saturday, March 2nd.—"D" Company, training at Tilbury; members wishing to attend this run must send their names at once to Sergt.-Inst. Cotton, R.E.

J. H. S. Phillips, Captain and Acting Adjutant,
Electrical Engineers R.E. (V.).

NOTES.

Gas Fatality.—On the 14th inst., at an inquest on a Mrs. Jordan (43), King Street, Rock Ferry, near Birkenhead, Dr. Noble said he had attended the deceased, and found her suffering from carbon-monoxide poisoning. She used a gas cooking stove supplied by the Corporation, and had complained of an escape of gas. He found an odour of gas in the kitchen. She died on Tuesday from paralysis of the heart and respiratory organs, set up by carbon-monoxide poisoning. Since this case he had attended domestics and others suffering in the same manner. The reason was that the gas supplied by the Corporation was mixed with water gas, which, having no smell, gave no indication of escape. A verdict in accordance with the medical testimony was returned.

"The Relation of the Technical School to the Workshop."—This was the subject of a conference at Liverpool on Saturday last, under the auspices of the West Lancashire Branch of the Association of Teachers in Technical Instruction. Mr. Winterburn, Chairman of the Liverpool Municipal Technical School, expressed the fear that the evening continuation schools of Liverpool had been a failure. In his opinion it was too much to expect boys who were working all day to attend evening school. He suggested an alteration of apprenticeship regulations so as to allow boys on leaving school to work one half-day and attend a technical school the other half. Mr. W. T. Emery (secretary of the Liverpool Technical School) described the attitude of Liverpool employers towards technical instruction as, generally, one of supreme indifference. Some employers had refused to continue facilities, because apprentices had done so well that they had got better places elsewhere. Prof. Watkinson (Liverpool University) expressed the opinion that in trade schools, boys should be taught the principles underlying the skilled trades, the handling of tools and preparation of materials, and that scholarships should be provided in technical colleges and universities where the higher branches of the work could be taught.

Battery Cars for Railways.—The past few years have witnessed various experiments on German railways with storage battery cars which, it was thought, had been heard of for the last time. But this idea has proved fallacious, judging from the attitude of the Prussian State Railway authorities, who have had schemes under consideration for a number of years in respect of the proposed introduction of electric traction. It is, in fact, announced that electric motor-coaches are now to be installed on various sections of the Prussian-Hesse State Railways for the purpose of improving the passenger service. The first coaches, which are equipped with batteries and motors, have been completed and tested on the Berlin-Zossen Railway, in the presence of the Minister of Public Works and members of that department, and of the Berlin railway administration. Each motor-coach has seating accommodation for 60 passengers third-class, although one compartment can be reserved for second-class passengers if necessary. The motor-coaches have now been placed at the disposal of the Mayence railway administration, and are being used in the service on the lines Mayence-Ingelheim, Mayence-Ruffelsheim-Raunheim and Mayence-Oppenheim.

Suicide.—A report from Port Elizabeth states that on January 21st, at 10 o'clock p.m., Christopher George Morgue died in the Provincial Hospital. He was an electrician, and had recently been for a short time in the employ of the Corporation electrical engineers' department, from which employment he was discharged on the 15th inst. The same evening he entered the bar of the George Hotel, and ordered a glass of beer. He poured a powder into the beer, and after drinking it fell down in an apparent fit. He was removed to the Hospital, where he died. It is stated that deceased was a native of London, and had been in South Africa about three years, most of the time in Cape Town.

Electric Shock Fatalities.—On Thursday last week Mr. Walter Schroder, Deputy Coroner for Central London, opened an inquest at the Islington Coroner's Court with reference to the death of William Hampson, aged 47 years, who was killed on the previous Monday at the L.C.C. electric sub-station, Woodville Road, Mildmay Park, by an electric shock. Mr. Cecil Rd. St. John, electrical engineer, in the employ of Messrs. Ferranti, Ltd., stated that on Monday he was engaged in reference to the installation of plants at three of the Council's sub-stations, one being at Woodville Road, Mildmay Park, and at which the deceased was employed. At 2 o'clock he gave him some instructions with regard to some work that he was to prepare for the fitter. The deceased at that time was at work at a vice some distance away from the high-pressure apparatus, and he being rated one of the unskilled labourers, had been cautioned that on no account was he to go near the live apparatus. A few minutes later he was called, and found deceased lying some 16 ft. away from where he left him, and that he was dead. He examined him, and came to the conclusion that he had apparently not received a shock, for there was no burning of the hands or body, and he should have expected to have found such if deceased had received a shock, for the voltage was 6,500. Deceased when found was 25 ft. away from the high-tension gear, and if he had received a shock it would not have been possible for him to have walked so far. Charles Smith, switchboard attendant at the Woodville Road sub-station, said that on looking down into the basement, which was reached by means of a ladder, he saw the deceased lying at the bottom flat on his face, with his arms under him. He turned him over, and finding that apparently he was dead, at once called assistance. He examined his hands and clothing, but could not detect any marks of burning. He noticed nothing to cause deceased to have fallen. He was 20 ft. away from the live apparatus. Mr. Arthur Leonard Johnson, charge engineer at the Woodville Road sub-station, stated that deceased, who was in the employ of the contractors, would not in any way be under his supervision, and he would have no business to be near to the high-tension gear. All men were cautioned not to go near it. Deceased, however, would work some 3 yds. away from it. Whilst a medical man was being obtained, he used artificial respiration. There was a mark on the forehead as if caused by a fall. Deceased, to get to the high-tension gear, would have to get over a barrier 2 ft. high. If he did receive a shock from the high-tension gear, the voltage of which was over 6,000, he did not think it would have been possible for him to have got where he was found. Dr. Stevens said that when called, he found deceased quite dead. Dr. Spillsby, pathologist, of St. Mary's Hospital, who had made a post-mortem examination of the body of the deceased, stated that he found down the sides and back and across the shoulders a number of blue spots, and on cutting into them he found that they were hemorrhages. Internally he found that there was not sufficient disease to cause death. On examining deceased's clothing, he found that there was a slit which corresponded to the place where the hemorrhages were found on the body. In his opinion, owing to the hemorrhages, death was due to his having received an electric shock. The Coroner said that it being proved that death was from an electric shock, he must adjourn the case to enable H.M. Inspector of Factories to be informed of the case, for under the provisions of the Factory Act, he must be informed of the case and attend the inquest. The jury could, in the meantime, go and inspect the sub-station. The inquest was then adjourned.

An inquest was held at Ossett, on the 14th inst., on William Saville, aged 20, the son of Councillor Saville, of Wakefield, who was killed through coming in contact with a high tension terminal, at 6,000 volts pressure, in the Ossett sub-station of the Wakefield and District Light Railways Co. on the previous Tuesday. Evidence was called, from which it appeared that deceased accidentally touched the terminal, and a verdict of "Accidental Death" was returned.

Incandescent Film Lamp.—The *Electrical World* states that in addition to their "Helion" filament lamp, Prof. H. C. Parker and Mr. W. G. Clark have in process of development an interesting form of lamp for constant-pressure circuits, the light from which is developed in a conducting film lining the bore of a small quartz tube. A patent on this lamp was issued on February 20th, 1906. One of the interesting features of the lamp is that the quartz tube permits the passage of the short wave-lengths of ultra-violet light. The conducting film gives off a quantity of such rays, and it was found that the efficiency of the lamp could be increased by coating the surface of the tube with thorium oxide, which under the combined influence of the heat and ultra-violet rays, glows with the characteristic light of the Welsbach mantle. The consumption of power with the plain tube is about 2½ watts per candle.

Institution and Lecture Notes.—Institution of Mechanical Engineers.—The annual report of the Council was presented at the 60th annual general meeting of the Institution on Friday last. The total number on the roll at the end of 1906 was 4,982. The accounts showed a total revenue for the year of £13,733, and expenditure £11,543. The net capital of the Institution amounted to £44,507.

Gloucestershire Engineering Society.—Last week Mr. Leonard Johnston, general manager of the Gloucester Light Railways, read a paper on "Brake Mechanism in Relation to Electric Tramways."

Richmond Athenæum.—Dr. Harker, of the National Physical Laboratory, lectured to the members last week upon "The Electrical Furnace and High Temperatures."

Birmingham Metallurgical Society.—Last week a lecture on the "Uses of Electricity for Metallurgical Purposes" was delivered by Dr. Sumpner to a large audience.

Royal Institution.—The first of a series of lectures by Prof. J. J. Thomson, F.R.S., on "Röntgen, Cathode and Positive Rays" was delivered on Saturday last.

Royal Society.—At yesterday's meeting, Prof. T. Johnson read a paper, which was communicated by Dr. A. D. Waller, "On Electrical Seed-Testing."

Mr. W. J. Blackhall delivered an interesting lecture in the Technical Institute, Dundee, on Friday last, to the members of the Institute of Engineers on "The Generation and Distribution of Electricity both for Lighting and Power Purposes."

Under the auspices of the National Telephone Society, Mr. H. L. Webb delivered a lecture on "Telephony on the Continent of Europe" in the Technical College, Glasgow.

Salford Mayoral Festivities.—The Mayor and Mayoress of Salford (Alderman and Mrs. Frankenburg) entertained a large gathering at a conversazione at the Peel Park Museum on Monday, the 11th inst. On the following night the festivities were continued, the guests on this occasion being the workpeople engaged at Messrs. Isidor Frankenburg & Sons' Salford works. An interesting feature of the proceedings was the presentation to Mr. Frankenburg by his employés of a fine portrait of himself in oils, to commemorate his second years' office as Mayor. The presentation was made by Mr. Standring, secretary to the firm, and was suitably acknowledged by the recipient.

Copper Prices.—In view of the great importance of copper prices to the electrical manufacturing industry, the following observations made by the chairman of the Arizona Copper Co., Ltd., at the annual meeting held in London on Monday will be read with interest:—"For the previous year we had £361,000 of free profits. This year we have £503,000, a difference of £142,000. This has enabled us to propose a dividend this year of 105 per cent. Last year it was 75 per cent. This increase of dividend no doubt arises largely—mainly, I should say—from the increase in the price of copper. The price of copper obtained by us for the year ended September 30th, 1905, averaged about £66 per English ton. Last year it averaged £80 per English ton. We are now getting for our copper, I am glad to say, up to £109 for the English ton. I need not tell you the difference—it is nearly £30 a ton above the price of last year, and to all appearance the price of copper is to keep up. There is a great demand for it, and there is none in stock. You all see the notices in the newspapers in regard to copper, and there is no appearance that we shall have any falling away in the price."

Educational Notes.—South-Western Polytechnic (Chelsea).—Lord Alverstone, G.C.M.G., Lord Chief Justice of England, will present the prizes and certificates to students of the evening classes and the day college on March 15th, at 8 p.m.

Taxation of Electricity in Russia.—The Russian Ministry of Finance have placed before the Ministerial Council a legislative scheme in regard to the decision to introduce an excise at the beginning of 1908 on electrical energy and illuminating gas used for lighting purposes, exclusive of energy employed for galvanic and thermo-electric installations, and of acetylene gas obtained from carbide of calcium. It is stated that the scheme provides for the levying of a tax on electrical energy and gas which are utilised for motive power and heating purposes, if the motors or apparatus use electricity or gas supplied from a general network of cables which are intended for lighting purposes, and have no special meters. The amount of the excise is proposed to be 4 copecks (about 1d.) per kilowatt-hour for electrical energy employed for lighting and 4 copecks per 100 cubic feet of illuminating gas. A fine of £100 and imprisonment for three months are in contemplation for contraventions of the law.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—In our reference to the appointment of Mr. H. S. Ellis, mentioned in our last issue, we, in error, described the office that Mr. Ellis has gone to assume at Bradford as that of deputy electrical engineer. The appointment is really that of *assistant electrical engineer*; no action has yet been taken to appoint a deputy electrical engineer.

The Neath R.D.C. has appointed Mr. H. B. Lloyd as manager of the electricity works at a salary of £140 per annum.

The Middlesbrough T.C. has increased the salary of Mr. Taylor, electrical engineer, by £25 per year. The Committee recommended an increase of £50, but the above decision was carried by 13 votes to 12.

The Acton District Council, on Tuesday, increased the salary of the electrical engineer, Mr. J. Martin Blair, from £225 to £260, rising by annual increments of £30 to £350 per annum.

On Saturday night a complimentary dinner was given by the Bradford Electricity Committee to Mr. Alfred S. Blackman, who has just relinquished the appointment of electrical engineer there, to take up a similar position at Sunderland, and a presentation was also made to him. In returning thanks, Mr. Blackman burst a bomb-shell upon the company, which included many members of the Corporation, by denouncing the scheme of consolidation of accounts which has recently met with the favour of the Corporation. He said he did not believe in consolidation, as it was interpreted in Bradford. To his mind, it spelled nothing but depreciation, and if it went on, the electricity accounts would go from bad to worse, and would in the future land in a state of chaos (cries of "Question"). This parting shot came as a great surprise, and acted rather as a wet blanket thrown over the proceedings.

The selection of an electrical engineer to the Belfast Corporation has been postponed for a week, owing to the absence of Sir Daniel Dixon, Bart., M.P., in London. The salary of Mr. V. A. H. McCowen, ex-electrical engineer, and now of Salford, was £800 per annum, and the Council offered him £1,000 to retain his services.

Mr. F. West, senior clerk at the Southwark Electric Light Station, has accepted an appointment under the Marylebone Borough Council.

Tramway Officials.—The salary of Mr. J. Bowden, rolling stock superintendent, is recommended by the Highways Committee of the L.C.C. to be increased from £400 to £450 per annum.

A correspondent writes:—"A Devonian, Mr. J. J. Bodley, formerly of Exeter, is taking a leading part in an important work which is now going on in Adelaide. A Bill has recently been passed for the acquisition of the whole of the tramways in Adelaide with a view to working them as one concern, and electrifying the whole system. Mr. Bodley, who has been the secretary for the chief companies, has been engaged in negotiations which have led to the acquisition by the Government, and will occupy the chief executive position under the new order of things."

General.—Mr. H. St. Hill Mawdsley, who has acted for the past 11 years as chief engineer and assistant manager to Newton's, Ltd., of Taunton, has lately resigned his position in order to take over the works of the Lister Electric Manufacturing Co., of Dursley, with the intention of manufacturing the "Mawdsley" zone dynamo, which he introduced some four years ago. Mr. John W. Burleigh has been appointed chief engineer in his place. As chief assistant engineer, Mr. Burleigh has taken an active part in the design and perfecting of this machine, which Messrs. Newton's will continue to manufacture. Before leaving Taunton, a presentation was made to Mr. Mawdsley, at a farewell smoking concert, of a handsome clock and bronze statuettes, by Mr. H. N. Hickley, the managing director, "in recognition of the great interest he had always taken in the welfare of the employés of the company."

It is reported that Mr. A. H. Stanley, manager of the Street Railway Department of the New Jersey Public Service Corporation, has resigned from that position in order to take over the management of the Underground Electric Railways Co. of London.

Mr. S. I. Crookes, of the Battersea Polytechnic, has been appointed Head of the Electrical Engineering and Physics Department in the Auckland Technical College, New Zealand. A new college (cost £50,000) is being built as a "Seddon Memorial." Mr. Crookes had charge of the electrical engineering classes in the Day Technical College at the Battersea Polytechnic, and was chief assistant to Mr. Frank Broadbent, M.I.E.E., who had charge of the evening technical classes in electrical engineering in the same Institution during the session 1905-6. During the same session Mr. Crookes gave a special course of lectures on electrical engineering to members of the Amalgamated Society of Engineers in the S.W. district, and by request of the same society is giving another course dealing with "Alternating Currents and Alternating-Current Machinery."

It is reported from Pittsburg, U.S.A., that the Western University of Pennsylvania will confer degrees upon Sir Wm. Preece and Mr. Marconi, and others who will be present at the Founders' Day celebrations of the Carnegie Institute on April 13th next.

It is reported that a marriage has been arranged between the youngest daughter of Sir Thomas Brocklebank, Bart., of Irton Hall, Cumberland, and Woolton, Liverpool, and George, only son of Mr. George Westinghouse.

Obituary.—David Lumsden.—It is with very deep regret that we have to announce the death—which occurred on Tuesday, 19th inst.—of Mr. David Lumsden, who during a very lengthy period in connection with the telegraph service had become endeared to a wide circle of friends. He was born in 1833, and 20 years later entered the service of the Electric and International Telegraph Co., at Leith, as a clerk. Entering later the engineering section promotion followed promotion until in 1866 he was transferred to headquarters in London as scientific assistant to the engineer-in-chief, in which capacity he effected many improvements in telegraph apparatus, and did a good deal of work in the development of the Wheatstone instruments, introducing also several methods of testing for faults in submarine cables. In 1870, on the transfer of the telegraph system to the Post Office, Mr. Lumsden was appointed electrician and submarine superintendent, but the dual appointment was cancelled in 1878 owing to the submarine department calling for all Mr. Lumsden's attention. Indeed, it is said by a writer in the *St. Martin's-le-Grand*, that "The Admiral," as he was called, was never happier than when he had a cable by the "lug" on board the *Monarch*, and when he was about to make a "splice." He retired from the Post Office service in 1898, but since his retirement he has taken the greatest interest in everything connected with the telegraph world, particularly submarine work. He enjoyed good health up till two years ago, when he had a serious illness, which he overcame by virtue of his iron constitution. It left him considerably weakened, however, and he has been slowly failing, until a few months ago when definite symptoms appeared. Uncomplaining, though suffering acutely, throughout his illness, he kept his indomitable spirit to the end. The funeral is to take place to-day at Norwood at 12.15 p.m.

H. Moissan.—We regret to learn, as we go to press, of the death of M. Moissan, of Paris, following an operation. His name will ever live in the memory of electrical men, and in the history of electro-chemical achievement, by reason of his chemical experiments at high temperatures and his work in the production of diamonds artificially. It will be remembered that he was awarded the Nobel prize last year. His death occurred on Wednesday morning at the age of 55 years.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Concordia Electric Wire Co., Ltd. (74,416).—This company's annual return was filed on December 19th, when the entire capital of £2,000 in £1 shares had been taken up. £1 per share has been called up on 7 and 5s. per share on 1,993, resulting in the receipt of £505 5s. Mortgages and charges: Nil.

Electrolytic Alkali Co., Ltd. (64,360).—Issue on January 14th of £1,700 4½ per cent. first mortgage debentures, part of series created July 9th, 1904, to secure £70,000, charged on the company's undertaking and property, present and future, including uncalled capital. Trustees: Liverpool Mortgage Insurance Co., Ltd., 6, Castle Street, Liverpool. Previously issued of same series: £23,300.

Cox-Walkers, Ltd. (Electrical engineers, Darlington) (88,588).—£3,000 5 per cent. debentures (two series, of £2,000 and £1,000 respectively), created December 20th, 1906, and dated January 25th, 1907, charged on the company's undertaking and property, present and future, including uncalled capital, have been registered. No trustees. Holder: E. Cox-Walker, Highfield, Darlington.

Ecco Battery and Electrical Co., Ltd. (Walthamstow) (91,032).—£1,000 6 per cent. debentures, created and dated January 11th, 1907, charged on the company's undertaking and property, present and future, including uncalled capital, have been registered. No trustees.

Nairobi Electric Power and Lighting Co., Ltd. (87,728).—A charge dated January 23rd, 1907, to secure £16,000, has been registered. Property charged: Moneys paid and to be paid in respect of calls upon 10,000 shares allotted to E. H. Bayldon, and 6,000 shares, to which R. C. Bayldon is entitled. Holders: Crown agents for the Colonies, Whitehall Gardens, S.W.

Provincial Tramways Co., Ltd. (6,445).—This company's annual return was filed on December 29th, when 10,000 preference, and 24,912 ordinary shares had been taken up out of a nominal capital of £400,000 in £10 shares (10,000 preference). £61,860 is considered as paid on 6,186 shares, and £287,260 has been paid in cash on the remainder. Mortgages and charges: £121,500.

British Tramways and General Construction Co., Ltd. (78,031).—This company's annual return was filed on January 3rd, when 241,000 shares had been taken up and paid for in full out of a nominal capital of £300,000 in £1 shares. Mortgages and charges: Nil.

Gilbert Arc Lamp Co., Ltd. (52,679).—This company's annual return was filed on January 30th, when 1,405 shares had been taken up out of a nominal capital of £2,000 in £1 shares. £1 per share has been called up on 705, resulting in the receipt of £700. £5 remains in arrears. £700 is considered as paid on the remainder. Mortgages and charges: Nil.

Sun Electrical Co., Ltd (63,261).—This company's annual return was filed on January 10th, when 13,764 preference and 10,000 ordinary shares had been taken up out of a nominal capital of £50,000 in £1 shares (20,000 preference). 4,600 of the ordinary shares have been surrendered. £1 per share has been called up, resulting in the receipt of £23,764. Mortgages and charges: £5,500.

Cape Electric Tramways, Ltd. (54,636).—This company's annual return was filed on January 9th, when 491,222 shares had been taken up out of a nominal capital of £500,000 in £1 shares. £91,222 has been received and £400,000 is considered as paid. Mortgages and charges: £56,700.

Marconi International Marine Communication Co., Ltd. (65,759).—This company's annual return was filed on January 15th, when 204,056 shares had been taken out of a nominal capital of £350,000 in £1 shares; £99,056 has been received, and £105,000 is considered as paid. Mortgages and charges: £16,000.

Burmah Electric Works Syndicate, Ltd. (63,563).—This company's annual return was filed on January 31st, when the entire capital of £2,000 in £1 shares had been taken up; 6s. 1½d. per share has been called up, resulting in the receipt of £615. Mortgages and charges: Nil.

Electric Vehicles Development Co., Ltd. (London) (89,213).—Issue on January 10th of £200 4 per cent. debentures, part of series created September 26th, 1906, to secure not more than £3,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £1,410.

Amazon Telegraph Co., Ltd. (44,532).—This company's annual return was filed on December 12th, when the entire capital of £250,000 in 25,000 shares of £10 had been taken up. £240,000 is considered as paid. Mortgages and charges: £242,100.

Electromobile Co., Ltd. (75,139).—This company's annual return was filed on December 14th, when 35,924 ordinary and 5,000 deferred shares had been taken up out of a nominal capital of £50,000 in 45,000 ordinary and 5,000 deferred shares of £1 each. £1 per share has been called up on 29,000 ordinary, and £29,000 has been received. £11,924 is considered as paid on 6,924 ordinary and 5,000 deferred. Mortgages and charges: £7,280.

Porous Accumulator Co., Ltd. (57,526).—This company's annual return was filed on January 7th, when the entire capital of £3,000 in £1 shares had been taken up. £1 per share has been called up on 1,007, and £1,007 has been received. 1,993 shares are considered as fully paid. Mortgages and charges: Nil.

British "Every Ready" Electrical Co., Ltd. (71,891).—This company's annual return was filed on January 7th, when the entire capital of £3,000 in £1 shares had been taken up and paid in full. Mortgages and charges, £6,000.

Walsall Electrical Co., Ltd. (37,696).—This company's annual return was filed on December 14th, when 12,000 ordinary and 4,380 preference shares had been taken up out of a nominal capital of £25,000 in £1 shares (sub-division not shown). £1 per share has been called up on 10,000 ordinary and 4,380 preference, resulting in the receipt of £14,380. 2,000 ordinary are considered as fully paid. Mortages and charges, nil.

A.B.P. Accumulator Co., Ltd. (76,438).—This company's annual return, made up to December 26th, has been filed. 3,106 preference and 14,000 ordinary shares have been taken up out of a nominal capital of £20,000 in 6,000 preference and 14,000 ordinary shares of £1 each. £3,106 has been received on the preference and £14,000 is considered as paid on the ordinary. Mortgages and charges, £17,500. A resolution that the company be wound up voluntarily was passed on November 8th, and confirmed on December 6th, 1906.

Suppliers' Construction Co., Ltd. (66,081) (formerly known as Charing Cross and City Electric Co., Ltd.).—This company's annual return was filed on January 3rd, when the entire capital of £350,000 in £10 shares had been taken up and paid for in full. Mortgages and charges: Nil. Name changed on March 4th, 1905.

London Electric Warehouse Co., Ltd. (67,568).—This company's annual return was filed on January 16th, when 8 shares had been taken up out of a nominal capital of £1,000 in £10 shares. £10 per share has been called up, resulting in the receipt of £10. £70 remains in arrears. Mortgages and charges: Nil.

Burmah Tramways Construction Co., Ltd. (74,455).—This company's annual return was filed on January 18th, when the entire capital of £50,000 in £10 shares had been taken up. £10 per share has been called up on 4,000, resulting in the receipt of £40,000. 1,000 shares are considered as fully paid. Mortgages and charges: Nil.

Amalgamated Day Batteries Co., Ltd. (81,316).—This company's annual return was filed on January 4th, when the entire capital of £20,000 in £1 shares had been taken up. £1 per share has been called up on 5,000, and £5,000 has been received. 15,000 shares are considered as fully paid. Mortgages and charges: Nil.

I.T.E. Electric Co., Ltd. (89,782).—This company's annual return was filed on November 23rd, when 257 shares had been taken up and paid for in full, out of a nominal capital of £5,000 in £1 shares. Mortgages and charges: Nil.

Maxim Electrical Co., Ltd. (London) (84,426).—Issue on January 10th of £2,200 5 per cent. debentures, part of series created by resolutions of May 16th and November 29th, 1906, to secure £15,000 charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £9,000.

Kuettner, MacDonnell & Cookson, Ltd. (Electrical engineers, London) (83,916).—A debenture for £833 6s. 8d., dated January 16th, 1907, charged on the company's undertaking and property, present and future, including uncalled capital, subject to two debentures securing £750 and £1,000, respectively, has been registered. Holder: B. Cookson, 7, Imber Park Road, Esher.

CITY NOTES.

Notting Hill Electric Lighting Co., Ltd.

The directors' report for the year ended December 31st, 1906, shows that the expenditure on capital account during the year was £2,998, making a total of £231,358. Included in this the principal items are:—£2,194 for new mains, and £488 for new machinery erected at the Bulmer Place station. The cost of the joint station to date amounts to £180,765, and joint debenture stock amounting to £178,400 has been issued. This stock is subject to a cumulative sinking fund, which now amounts to £20,093, invested in trustee securities. The following table shows the progress of the company during the last five years:—

1902 ..	Equivalent of 8-c.p. lamps ..	99,497	Profit ..	£14,609	6	2
1903 ..	" " ..	116,380	" ..	15,018	4	7
1904 ..	" " ..	132,132	" ..	19,890	9	5
1905 ..	" " ..	143,102	" ..	19,983	12	7
1906 ..	" " ..	163,525	" ..	20,038	14	8

The number of consumers is now 2,529, and 98 per cent. of these are supplied at 200 volts.

The gross revenue for the year was £36,924, showing an increase of £1,610, and the total net profit was £20,039. After setting aside £2,200 for depreciation, renewal and reserve fund, and paying debenture interest of £2,560, and £1,981 for interest and £1,100 for sinking fund in respect of Kensington and Notting Hill joint debenture stock, £12,198 is available for dividend. The directors recommend the payment of the usual dividend of 6 per cent. on both the preference and ordinary shares (£8,310), and that the balance of £3,888 be divided in accordance with the articles of association, one-half, amounting to £1,944, being credited to the founders' shares and the other half to the ordinary and preference shares. This will enable a further 1½ per cent to be paid on both ordinary and preference, with a distribution of £3 10s. per share on the founders' shares. An interim dividend of 3 per cent. was paid to the holders of the ordinary shares on July 1st, and the balance of 4½ per cent. will be paid forthwith, together with the distribution on the founders' shares. The preference shares having received their full 6 per cent., the 1½ per cent. bonus will be added to the interim dividend on these shares, to be paid on July 1st next. The amount of rates, including the proportion of those on Wood Lane Works, amounted to over £3,000, being £750 in excess of the previous year. A second station is in course of erection at Wood Lane. On this station over £20,000 has been expended, although it has not yet been brought into use, and the company already bears its share of the interest and sinking fund on the additional capital. The capacity of both Wood Lane stations will be 9,500 H.P., and the maximum demand up to the present has been 4,500 H.P. This large amount of spare plant increases the cost of production; if, however, this station can be joined up with the stations of other companies, the necessity for so much spare plant will no longer exist, and considerable economies will be effected. Law and Parliamentary costs amounting to £363 were incurred during the year in opposing Electricity Bills brought forward by the L.C.C. and others, and in promoting the Bill to enable this company to amalgamate with other West London companies. No Bills, however, passed during the session.

This company is, in conjunction with the other electrical supply companies in London, promoting in Parliament a Bill called the London Electric Supply Bill, of which the following are the principal provisions:—

To authorise agreements between any of the companies for mutual assistance with respect to giving and taking supplies of electrical energy, and to provide generating stations, &c., in combination, including the establishment of a joint committee to control such stations if necessary for the purpose.

To empower any or all of the companies to amalgamate subject to the sanction of the Board of Trade.

To modify the existing power of purchase of the undertakings of the companies.

In consideration of the above to impose an obligation upon all the companies to supply electrical energy for power purposes or to authorised undertakers at a price not exceeding £4 per KW. per annum of maximum demand, and ½d. per unit for all energy supplied.

Electricity Generated, Sold, &c., During the Year.

Units generated and purchased	2,566,425
Units sold—Public lamps	81,841
Private consumers by meter	1,709,184
Total sold	1,791,025
Units used on works	25,329
Total units accounted for	1,816,354
Units expended in distribution, transformers and accumulators..	750,071
Public lamps	52
Maximum supply demanded	1,450 KW.

The meeting is to be held on Tuesday next, 26th inst., at Winchester House.

Westminster Electric Supply Corporation, Ltd.

The directors' report for the year 1906 says that the supply of current has increased from the equivalent of 764,930 lamps of 8 c.p., to the equivalent of 839,004 lamps, the largest addition in any one year. The length of roadway in which continuous-current mains have been laid now exceeds 80 miles, making about 310 miles of ways, into which upwards of 253 miles of copper (strip and cable) have been drawn. In addition 3 miles of trunk mains (12 miles of ways) are laid in the company's area to connect the stations with the Central Electric Supply Co.'s station at St. John's Wood. The Bill promoted in the last session of Parliament by this company in conjunction with other West-End supply companies, to enable economies to be made in the supply of electricity was not allowed to proceed, and the Committee appointed by the House of Commons rejected the L.C.C. Electric Supply Bill after prolonged investigation. Heavy Parliamentary expenses were, therefore, again incurred last year in protecting the company's interests. The L.C.C. has deposited a new Bill for the ensuing session, and a company which has before sought powers to compete with existing undertakers is again coming forward, so that considerable Parliamentary expense will be necessitated. The directors are supporting, in common with the whole of the supply companies in London, a Bill to authorise the companies to act in combination for the purpose of bulk supply, being satisfied that if adequate facilities were granted to the existing companies, there would be no need whatever for the provision of a supply in bulk by any outside body. Such a solution is more in the interests of the users of electricity than the proposal of the L.C.C. to spend millions of pounds of public money in order to provide a supply which is never likely to be remunerative and which must for years involve a heavy loss. In consequence of increased assessment, the Corporation had to pay nearly £5,000 more for rates in addition to paying indirectly their proportion of those of the Central Electric Supply Co. In all, the extra rates amounted to over 1 per cent. on the ordinary share capital of the Westminster Co. In accordance with the provisions of the L.C.C. Thames Embankment Improvements Scheme, the Council have now provided a site in Horseferry Road to replace the company's station in Millbank Street, which they acquire by arbitration under the terms of their

Act. An interim dividend, at the rate of 11 per cent. per annum on the ordinary shares and the dividend on the 4½ per cent. preference shares, for the half-year ending June 30th, 1906, has been distributed. After allowing for depreciation, sinking fund and other charges, the net balance is £44,653, from which must be deducted the second half-year's dividend on the preference shares, which absorbed £8,686, leaving a balance of £35,967. Out of this the board recommend the payment of a dividend at the rate of 13 per cent. per annum, less income-tax, for the past half-year, carrying forward a balance of £2,004.

ELECTRICITY SOLD, &c., DURING 1906.

Sold to consumers	15,750,146
Used on works for lighting, meter testing, &c... ..	160,911
Total	15,911,057
Number of lamps on circuit, December 31st, 1906 ..	839,004

The annual meeting is to be held on Wednesday next, at Eccleston Place, S.W.

Great Northern, Piccadilly and Brompton Railway Co.

SIR G. S. GIBB presided on Thursday last week at this company's half-yearly meeting held at Hamilton House.

In moving the adoption of the report (see ELECTRICAL REVIEW, February 15th, page 276) he congratulated them upon the practical completion of the undertaking. They had still to finish the short spur from Holborn to the Strand, which they hoped to open for traffic in the autumn, and some work still remained to be done at Covent Garden and Mayfair. With those exceptions everything necessary for the full operation of the railway had been finished. He expressed the thanks of the directors and proprietors to all the officers of the Underground Electric Co. and of this company, who had been engaged in the execution of works and the administration of affairs during the construction period. The whole of the works had been carried out in a way which reflected credit on all concerned. The services of Mr. J. R. Chapman, the chief engineer, Mr. Mandelich, the secretary, and others were specially mentioned. The accounts showed that the capital expenditure during the half-year had been £844,013. The further capital expenditure estimated to be incurred during the current half-year was £300,000. The balance at the debit of capital account amounted to £1,111,453, and this was made up of £846,641 owing to the Underground Electric Co. and £265,000 which represented the contractors' retention fund. The capital powers and assets available after clearing off the balance of the debit of capital account, was £623,746. Some months ago they looked forward to the opening of the railway in January, but the works got forward so quickly that they determined to expedite the opening, and by arrangement with the contractors, the public opening was held on December 15th. They were greatly indebted to Mr. Lloyd-George, President of the Board of Trade, for performing the opening ceremony. They felt that the undertaking was started with the good wishes of the Government authorities most readily and heartily given. The principal difficulty at the opening of a new line was the difficulty of getting the public to realise the existence of the new facilities. Only those who were brought into daily contact with such matters realised how extraordinarily difficult it was to get the people to know of new facilities, although they might be at their very door. They advertised the line very freely. They had to choose between two courses; they might have started on a moderate service, adjusting it to the traffic requirements and increasing it as traffic naturally grew, or they might start it at once with a full and liberal service and persevere with that in the hope that it would attract the public and get a more rapid development. The directors chose, he thought wisely, the latter course. They were now running a service of trains at little over two minutes' interval in the busy hours, and a fraction over three minutes at the slack hours. They did the journey from Finsbury Park to Hammersmith in 35 minutes, including all station stops, and from Finsbury Park to Piccadilly in 18 minutes; therefore, as regards frequency and speed—two principal factors in any urban train service—it would be recognised that they were offering the public good facilities. Since the opening, everything connected with the operation had gone smoothly and well. There was one point that gave them special satisfaction. In all lines for the use of electric traction the question of wear of rails was an important one. He was glad to say that their experience of the Piccadilly line showed that they were getting less wear of rails—that was a better service out of their rails—than any electrically-worked line with which he was acquainted. In regard to the fixing of fares, they had to choose between two systems—(1) uniform fares, (2) differential fares, and they had to remember that tube railways cost an enormous sum to make, and the fares must be fixed with some reference to the cost of construction of the railway. He was decidedly in favour of low fares, but it was a mistake to make them too low. They must be fixed at reasonable figures in the interests both of the proprietors and, in the long run, of the public. They decided to adopt the system of differential fares on the Piccadilly tube. In London traffic one of the most important factors was the existence of the ubiquitous 'bus competition, and if they had adopted a uniform fare for the whole line they would practically have had to give up any hope of getting what one might call short-distance traffic. Any uniform fare would necessarily have been too low for the longest distance and too high to enable them to get traffic for short distances. Both extremes, in his judgment, should be avoided on a line like this. It was better to adjust the fares carefully to the circumstances of the traffic. They had had some experience in the matter on the Bakerloo tube. They started on the uniform 2d. fare, and after some experience they altered it to a system of differential fares, and he thought the result had been quite successful. The traffic there was growing exceedingly well, and they were finding that they got very good traffic indeed at fares below 2d., while at the same time securing satisfactory traffic at fares above 2d. It was thought that a tube would not be able to get people to travel between adjoining stations, but on the Bakerloo tube they got as many as 1,000 passengers a day travelling simply between one station and the next. They had now had a short experience of the results of the fares on the Piccadilly tube, and up to the present were quite satisfied with the scale adopted. The figures for a recent week showed that they carried 39 per cent. of their traffic at 2d. fares; 21 per cent. at fares below 2d.; and 39 per cent. above 2d. There was no doubt that their traffic at fares below 2d. would show large growth. In watching the results, they must be guided by experience, and not become the slaves of any one system. They intended to reduce the fares shortly, finding that there were some stations where they did not think they were getting as much traffic, or as much money, as they would receive by charging at particular stations 1d. and 1½d., and so they were going to alter the fares, and proceed in that way to get their scale ultimately as perfect in its adjustment as they could make it. The chairman next referred to the arrangements which had been made for through bookings over other railways and the London United Tramways, and the probabilities of large growth of traffic resulting therefrom.

LORD GEORGE HAMILTON seconded the motion, and it was carried.

The dividend resolution (4 per cent.) having been approved, the retiring directors and auditors were re-elected.

Kensington and Knightsbridge Electric Lighting Co., Ltd.

THE directors' report for 1906 says that the number of houses and shops connected with the system has increased from 3,693 on December 31st, 1905, to 3,977 on December 31st, 1906, while the number of lamps (8-C.P. basis) has increased from 326,827 to 353,532. The renewal account now stands at £66,379, being an increase of £8,708 over the amount of the account at the end of the previous year. After providing for the amount placed to renewal account, and after paying the dividends on the 6 per cent. first preference shares to June 30th, 1906, on the 5 per cent. second preference shares to September 30th, 1906, and an interim dividend at the rate of 10 per cent. per annum on the ordinary shares for the first half year, the balance standing to the credit of the net revenue account for the year 1906, is £12,017. Of the above sum £1,500 has been appropriated to the payment of the first preference dividend to the end of the year, and £625 has to be set aside to meet the portion of the dividend on the second preference shares accrued to the same date. It is proposed to pay out of the balance of £9,892 a further dividend on the ordinary shares at the rate of 10 per cent. per annum for the past half-year, making with the interim dividend paid on August 1st, 10 per cent. for the year. This will leave a balance of £4,642 to be carried forward. During the year further substantial reductions have been made in the charge for supply, representing a considerable saving to the consumers. After the general meeting there will be an extraordinary general meeting for the purpose of confirming the resolution passed on the 7th inst., relative to the Bill now being promoted by this company in conjunction with the whole of the other electric supply companies in London, the purport of which has been brought fully to the attention of the shareholders.

The annual meeting is to be held on 28th inst. at 148, Brompton Road, S.W.

Cambridge Electric Supply Co., Ltd.

THE directors' report shows that during the year 1906 there have been connected the equivalent of 3,043 8-C.P. lamps, making a total to date of 53,379. The number of units supplied during the year has been 596,456, an increase of more than 36,000 units. During the year a complete new range of steam pipes has been installed. A new transformer sub-station has been built and the supply mains have been extended in several directions. An appeal has been lodged during the year against the increased rating assessment on the company's undertaking and a substantial reduction has been obtained. The accounts of the company show a total profit for the year of £7,525, which, added to £1,392 brought forward from 1905, makes £8,917. After deducting debenture and other interest £1,398, placing £1,506 to depreciation fund account, which will bring up the total placed to the credit of that account to £10,000, and writing £250 off suspense account, there remains a balance of £5,763. An interim dividend of 2½ per cent., absorbing £2,120, has already been paid, and the directors recommend the payment of a further dividend of 3½ per cent., making 6 per cent. for the year. This will absorb £2,968, leaving a balance to carry forward, subject to adjustment of income-tax, of about £680.

The meeting is to be held on Wednesday next.

Oxford Electric Co., Ltd.

THE directors' report for 1906 says that the revenue account shows a profit (including £1,049 brought forward from last year) of £13,597. After providing £2,040 for debenture and other interest and writing off £673 on account of hire-purchase installations, the balance available for dividend is £10,884, which the directors pro-

pose to appropriate as follows:—Dividend at the rate of 7 per cent. per annum on the ordinary shares (whereof 2½ per cent. was paid in September), £7,000; 5 per cent. preference dividend, £376; to credit of reserve and renewal of plant account, £2,612; leaving a balance to be carried forward, £896. During the year £1,112 has been expended in plant replacements and charged against reserve and renewal of plant account. With the proposed appropriation from the profit of the year of £2,612, this account will then amount to £12,500. It is estimated that at December 31st last there was the equivalent of over 80,000-c.p. lamps connected to the mains. The number of Board of Trade units sold during 1906 was 8 per cent. larger than in the previous year. Notwithstanding a reduction in the price of current to large consumers, the revenue from sales by meter has increased by £1,203. The capacity of the generating station has been increased by the provision of a 200-kw. three-phase dynamo. A new sub-station at South Parade has been erected and equipped to supply the growing demand at Summertown, and two additional transformers, of a total capacity of 108 kw., have been installed in other sub-stations. The supply mains have been extended in the Banbury, Woodstock, Lathbury, Warnborough and St. Mary's Road, and in St. Clement's, South Parade and Walton Street. The high tension system of mains has been extended to connect Summertown sub-station.

The meeting is to be held at Oxford on Friday, March 1st.

Metropolitan District Railway Co.

The directors' report for the half-year ended December 31st, 1906, shows that the expenditure on capital account during the half-year was £75,396. The gross receipts amount to £215,846, being an increase of £12,336 on the receipts for the corresponding half of 1905. The working expenses amount to £155,719, being an increase of £11,643, which had been mainly due to a fuller expenditure on maintenance. After providing for rent charges, interest on debenture stock, and other charges, the net revenue account shows a deficit of £38,485. To this deficit must be added the sum of £9,375, being the company's proportion of net revenue arising from the City line's joint undertaking, which, although included in the net revenue account, is not available for payment of debenture interest, being specially appropriated to the payment of dividend on the 4 per cent. guaranteed stock. With the above-mentioned addition, the deficiency for the half-year chargeable to capital under the company's statutory powers is £47,860. The dividend payable on the 4 per cent. guaranteed stock is at the rate of £1 10s. per cent. per annum, which will be paid on February 27th. The increase in working expenditure is exhibited in the following table:—

	Half-year ended Dec. 31, 1905.	Half-year ended Dec. 31, 1906.	Increase.
Maintenance of way and works ..	£15,054	£26,391	£11,337
Maintenance of rolling stock ..	15,103	19,224	3,921
Train working and traffic expenses, after deducting the balance of accounts for work done for and by other companies	75,794	73,332	dec. 2,462
Rates and taxes	19,198	20,646	1,448
Other items	18,727	16,126	dec. 2,601
	£144,076	£155,719	£11,643 = 8·08 %

The following table gives a summary of comparative figures for the second halves of the years 1905 and 1906:—

	Half-year ended Dec. 31, 1905.	Half-year ended Dec. 31, 1906.	Increase.	Or per cent.
Passengers, including workmen and season ticket holders' journeys	28,282,431	30,182,137	1,899,706	6·72
Passengers carried at workmen's fares	7,585,940	8,674,790	1,088,850	14·35
Passenger receipts	£185,728	£199,287	£13,559	7·30
Average receipt per passenger ..	1·58d.	1·52d.	—	—
Train-mileage on District Railway	1,034,456	1,182,544	148,088	14·32

The revision of fares was carried into effect on September 1st last. The comparative table shows that notwithstanding the increases made in some of the fares the average receipt per passenger is unchanged. This is due to the large increase which has taken place in the number of passengers carried east of Mansion House who pass over only a few chains of line belonging to this company, and for the carriage of whom this company only receive a trifling sum, the actual figures being an increase of about 2 million passengers carried, for a gross receipt of which the District proportion was £190. Apart from these unprofitable passengers the increase in the average fare per passenger since the revision of fares took place has amounted to about one farthing per passenger. The directors consider that this increase, whilst not imposing any unreasonable burden on the public using the frequent trains which are now being run, has placed the future earning capacity of the undertaking on a more satisfactory basis.

The opening of the Piccadilly tube (Hammersmith to Finsbury Park) has diverted a considerable number of passengers from this company's line, but the new route across London, and the valuable facilities for travel afforded by it, will, the directors believe, create so much additional traffic that this company will soon gain more than they have lost. The development which the new line will bring to the districts served by the Wimbledon and Putney Bridge line, and the lines west of Hammersmith (on the latter of which many fares were reduced on the opening of the Piccadilly tube, in order to aid the expected development) will be greatly to the advantage of this company. Through fares are now in operation between this company's stations and stations on the Piccadilly tube, and also with the London United Tramways, and the public are already taking advantage of these facilities in increasing numbers. Negotiations are proceeding satisfactorily with the London, Tilbury and Southend Co. in regard to the payment by that company for the working by this company's rolling stock of the train services run to and from East Ham, but the directors of the Tilbury Co. have thought that whilst these negotiations are pending it is undesirable that Mr. Stride should be a member of the boards of both companies. Mr. Stride has consequently retired from the board of this company, and by his retirement the directors lose a most valued colleague. The vacancy on the board thus created has been filled up by the election of Mr. John Young, of Woking, to be a director of the company.

Mileage Statement.

Half-year ended Dec. 31st, 1905. Miles worked over.			Miles authorised.	Miles constructed	Miles constructing or to be constructed	Miles worked over.
M.	C.		M. C.	M. C.	M. C.	M. C.
24	10	Lines owned by company	28 49	24 24	4 25	24 10
3	58	Do. partly owned ..	3 58	3 58	—	3 58
0	6	Do. jointly leased ..	—	—	—	0 6
0	38	Do. worked	—	—	—	0 38
18	68	Foreign lines worked over	—	—	—	18 68
47	20	Total	32 27	28 2	4 25	47 20

Train and Car-Mileage on District Railway.

Half-year ended Dec. 31st, 1905. Total miles run by District trains, including mileage, on joint and foreign lines.	Train-Mileage.	Half-year ended Dec. 31st, 1906. District Co's trains.	Other companies' trains.	Total.	Total miles run by District trains, including mileage, on joint and foreign lines.
284,943	Passenger trains—Steam (L.N.W. only in 1906)	—	8,482	8,482	...
1,117,443	Passenger trains—Electric	1,010,457	160,556	1,171,013	1,623,758
444	Goods and mineral trains (Midland, &c.) ...	284	2,765	3,049	542
1,402,830	Total	1,010,741	171,803	1,182,544	1,624,300
8,532,587	Passenger car-mileage	3,970,222	1,225,265	5,195,487	7,048,962

Smithfield Markets Electric Supply Co., Ltd.

Mr. H. S. Leon presided on Friday last at the annual meeting held at Winchester House.

In moving the adoption of the report (see Electrical Review, Feb. 8th, p. 237), the Chairman said that the amount spent on capital account during 1906 was £1,500. The mechanical stokers to which he referred last year were now installed, and the greater part of their cost had been paid. So far as they had been in use they had quite justified their expenditure. In the full year of 1907 the coal saving should be even more developed. In regard to the revenue account, although the output in units was 30 per cent. larger in 1906 than in 1905, the expenditure in 1906 was £100 less than in 1905. He was sorry to say that it was not possible to anticipate that that could be repeated this year, because of the price of coal which was continually tending upwards. A large part of their coal contracts for the year had already been made at about 3d. or 4d. more than last year, but for the balance they would have to pay more. It was just as difficult to conduct a successful speculation in coal as in anything else. The decrease of £1,400 in net revenue was due not to the amount of electricity sold but to the reduced price obtained both for lighting and power, and rates and taxes had increased by no less than 80 per cent. over 1905, due almost entirely to an increased assessment. The rates and taxes now paid represented fully 1 per cent. of the ordinary share capital. This was most unreasonable, and he thought they could fairly claim an alteration in the assessment when the time came. They had no longer received the £1,500 from the cold store in the form of rent. The whole of that sum except £95 odd had been absorbed by the cold store on account of current supplied. They had lost their chief engineer (Mr. Ridley), who was a most valuable servant of the company, but had improved himself by taking a new post. They had raised their second engineer to the position of chief, and up to now every satisfaction had been given. Turning to the statement in the report that the dividend must be passed, he said that he was extremely sorry that anyone should have thought that the board wanted to conceal anything from the shareholders by not placing the reason for passing the dividend in the report. It was perfectly true that some explanation might have been printed, but it could only have been a very imperfect or incomplete one, and would probably have given

just as much dissatisfaction as by their saying nothing about it. They thought it best to say little, and leave all reasons to be given at the meeting. The contract with the City Corporation expired in 1913, and the continuance of the company's business in the present premises depended entirely upon the goodwill of the Corporation. They were not a company authorised by Parliament or fortified with a provisional order. In February last the auditors quite rightly—and he was much obliged to them for doing it—wrote to the board a letter which he (the chairman) read last year, pointing out that consideration should be given by the directors to the policy to be adopted for the capitalisation of its revenue in view of the contract expiring in 1913. The board then proceeded to consult its lawyers, and immediately took advice of counsel as to whether the company was justified in paying out more cash dividends before a new contract for a longer period was made by the Corporation. Counsel advised that it was not justified in so doing, and that until a fresh arrangement should be arrived at with the Corporation, it would be wise to conserve all cash assets as the property of the debenture-holders. Naturally the next step for the board to take was to approach the Corporation and to endeavour to obtain a new contract. They were granted an interview with the committee of the Corporation appointed to deal with the matter. They were most courteously received, and the case was given a full and sympathetic hearing. After some time the company was informed by the Corporation that its application for a new contract was, for the moment, premature. The board did not take that as a final answer, as a refusal, and it was to be hoped that when the right time came a fresh arrangement, fair to all parties, would be arrived at. Shareholders now knew exactly as much as the board itself about the case. Under those circumstances, and under the advice of the auditors and counsel, the company became for all purposes a debenture company. The position of the holders of debentures should be secured. All net profits were hoarded for their benefit, but against that it was very important to consider that—all reversions belonged to the shareholders after the debentures were paid off in full. That should be of some value. When all their contracts expired the markets must still be lighted, and no one would be in such a good position to light them as the company, and the value of the plant, plus the money which they would have in hand, should be enough to pay off the debenture-holders with, he trusted, a substantial sum for the benefit of the shareholders. However, they must not take this in the form of a prophecy—he was not going to make any prophecy as to the future, but he could only hope for the best. He was afraid that the trustees for the first debenture-holders might not permit the board, when the time came in 1909, to pay off the second debentures, but that matter was now *sub judice*, and they would have to be guided by the legal opinion demanded in a friendly way by the first debenture-holders. It might be of some interest to them to know that he was almost the largest shareholder in the company, and quite the largest debenture-holder in both classes of debentures, and he trusted they might take it as some sort of an assurance—not an insurance—that the interests of all three classes would be looked after. The board had had the courage during the last few months to buy £3,300 of the first debentures in the open market, and had cancelled them. That reduced the amount of the outstanding first debentures to £46 700. It was obvious to all what an enormous profit there must be to the company by that transaction, against which it must be remembered that the cash reserve fund was reduced by the price paid for the stock. Before buying that stock, they were legally advised that the directors were quite justified in taking advantage of the opportunity of buying the stock in the open market at a low price for the benefit of the company.

Mr. E. SCHENK seconded the motion.

Mr. G. H. BROUGHAM GLASIER (one of the original directors of the company, and the vice-chairman of the Charing Cross, City and West-end Co.) said that, at any rate, to the ordinary shareholder the remarks of the chairman would not be particularly pleasant. He ventured to suggest that there was no reason why the dividend which had been earned during the year should not be paid to the shareholders to whom it belonged. He failed to see any reason at all why the earnings of the company were, from the last dividend in 1905, to be accumulated for the payment of the debenture-holders. The debenture-holders' security, he took it, was to be the same thing that the shareholders subscribed their capital for, the company, the undertaking of the company and its assets. Now, how the debenture-holders could, as it was rather to be assumed they had, at this period, so many years before the existing licence from the Corporation of London had expired, take the profits which were now being made, he failed to see. The chairman had said that they took counsel's opinion on the matter, and that opinion appeared to have been made on the suggestion of the auditors. But he did not see why there was any necessity to take counsel's opinion upon a question of that kind, unless the debenture-holders themselves had taken some action which gave notice to the company that they were going to make an application to the Court to prevent the company from dividing the profits which they earned during the last year. He asked the chairman whether he was wrong. Were the debenture-holders in course of applying to them and giving notice that unless they reserved the whole of the profits for them, that they would take legal action to compel them to do it?

The CHAIRMAN said the trustees for the first debentures had not done so, but he had no doubt they would.

Mr. BROUGHAM GLASIER said that if they had not received such notice, he failed to see any legitimate reason for the board presenting that report intending to pass the dividend, and saying that they intended to accumulate the whole of the profits from the undertaking until 1913, and that those profits, which were legitimately those of the ordinary shareholders, were to be allocated to the debenture-holders as being something which was not secured to them under their trust deed. There might be some reason for it. He was largely interested in various electrical undertakings, and had had a good deal to do in connection with the Smithfield Markets undertaking itself, and knowing that there was a guarantee given by an exceedingly wealthy man in connection with this very matter, he failed to see any cause for the proposed action of the directors.

Dr. BUTLIN said that he had property in many companies, but he did not attend the meetings. He had come down because he was moved with curiosity. He never remembered in all his experience of 25 years to have received so singular a report and balance-sheet. Here was a company which was apparently doing very well, which had made a profit almost the same as last year, and paid 3½ per cent. to its ordinary shareholders, but, to his astonishment, the dividend was passed. He made inquiries in the City, and found that they held their lease at the goodwill of the Corporation solely, and had expended considerable money upon the worst possible security. They were a pack of fools to put themselves in the hands of the Corporation. It was his business as a shareholder to have looked into it, but he now saw that they were in a very difficult hole. He always liked to see a good fight made, but here he did not see what sort of a fight they were going to make. They had hoped to obtain from the Corporation a lease of 15 years, and under these circumstances they wanted to show a bold face to the Corporation and do everything they could to persuade them to give such renewal. They were gathering their clothes about them and collecting their money and saying to the Corporation that they did not in the least expect that they would have a renewal of the lease. If they were going to give up their lease they naturally hoped that the Corporation would give them something for their mains and property. When he looked at the accounts showing that everything had cost £123,000, he naturally thought the debentures were secured on the property of the company. He did not suppose that the property was worth £123,000, but he thought it was equal to two-fifths, which would cover the value of the debentures. It was a faked up account, and was of no value. They had a good lie on paper. They were now giving it out to the public that their property would not cover even the value of the debentures. He regarded that as a most singularly feeble policy to be taken in face of such serious difficulties.

The CHAIRMAN did not offer any reply at this stage, but put the resolution to the meeting, when only one hand was put up in favour of the report, all others present voting against it.

A very lengthy discussion ensued in which Mr. Brougham Glasier, the auditor (Mr. Rhodes), and the chairman took part. The auditor said that it was not a matter which was being brought forward in the interests of the debenture-holders. The time had arrived when they had in view the end of the licence in 1913. It was the company's duty, the directors' and the shareholders' duty, and it was the auditors' duty to see that the company's capital was conserved. The capital had been conserved up to a point by putting year by year certain sums to reserve, but the time came when they considered it necessary to point out to the directors as to whether the amount being put by for the past was sufficient. They went to counsel and were advised that it was not. The directors considered what sum would be sufficient in order to meet not only the debentures but as much of the capital as possible at 1913. They came to the conclusion that no amount anything less than the full earnings of the company for the time being was sufficient for the purposes. That was the reason the money was being put as explained. It was not for the protection of the debenture-holders, but for the protection of the company's capital in general. Mr. Glasier replied that the argument was fallacious, and the auditor said ditto regarding Mr. Glasier's statement, and after much more argument it was resolved that Mr. Glasier and Dr. Butlin should be a deputation from the shareholders to discuss the matter with the board.

The meeting was then adjourned until Friday, March 15th.

Chelsea Electricity Supply Co., Ltd.

THE directors' report to December, 1906, states that the profit for the year amounted to £31,814, which, with £916 brought forward and £289 balance of interest, makes a total of £33,019. After deducting interest on debenture stock, £7,875; interim dividend, 6 per cent. on preference shares, £900; interim dividend on ordinary shares at the rate of 4½ per cent. per annum, £5,562; there remains a balance of £18,683. Out of this the directors recommend that £11,129 be placed to credit of renewals and depreciation fund; that a final dividend be paid on the preference shares, making 6 per cent. for the year, £900; a final dividend on the ordinary shares at the rate of 4½ per cent. per annum, making 4½ per cent. for the year, £5,562; leaving a balance of £1,092 to be carried forward. The directors regret that, notwithstanding an increase in the number of units sold, the profits, for the first time in the history of the company, show a decrease as compared with those of the previous year. This decrease is attributable to—(1) An increase of upwards of £2,000 in the rates, the result of an increase of 90 per cent. in the assessment of the company's property made at the last quinquennial valuation. This accounts for one-half of the reduced profit. (2) The amount of unlet and unoccupied property in the district, which was unusually large during the year. (3) Reductions in price which have been made to customers, principally for power and heating purposes. The number of lamps connected on December 31st, 1906, was 233,305, an addition of 11,496 during the year, and the total number of units sold was 3,307,714, being 85,676 more than the previous year. The London Electrical

Supply Companies are promoting a Bill in Parliament to give them powers of association, which, if granted, should effect economies in the cost of production and enable them to deal satisfactorily with the question of bulk supply.

The annual meeting is to be held at Winchester House on Wednesday next, 27th inst.

National Electric Supply Co., Ltd.

The report of the directors for the year ended December 31st, 1906, showed that 135 new consumers and additions (10,721 8-c.p. lamps) had been connected to the mains. Extensions of mains had been laid to the extent of 2½ miles, and a chemical oil separator had been added to the plant at the works. The expenditure on capital account for the year was £3,200. 4 per cent. preference shares to the amount of £135 had been allotted, and loans at 4 per cent. interest had been accepted to the amount of £5,149 during the year. Loans to the amount of £5,857 had been repaid. The gross profit for the year was £13,499, which, with the balance from last year, made a total of £13,722. This has been appropriated as follows:—Interest on loans and bank interest, £1,815; reserve for depreciation on machinery, &c., £3,800; reserve for bad and doubtful debts, £150; payment of 4 per cent. per annum dividend on preference shares, £3,270; payment of interim dividend, at the rate of 3s. per share on the ordinary shares for the half-year ending June 30th, 1906, £1,627, and at the rate of 4s. 6d. per share on the ordinary shares making 7s. 6d. per share for the year ending December, £2,441; to payment of a dividend of £1 7s. 2d. each on the founders' shares of the company, £136; balance carried forward, £482. The plant and machinery have been maintained in a high state of efficiency, out of revenue.

Electricity Generated, Sold, &c.

Units generated	1,659,893
Quantity sold—Public lamps	64,089
Consumed per meter	1,466,000
Total sold	1,530,089
Quantity used on works	77,617
Quantity used in transmission	41,796
Total accounted for	1,649,452
Not accounted for	10,441
Public lamps	45 of 440-watts.

The annual meeting was held at Preston on 7th inst., Mr Booth presiding. The chairman referred to the very encouraging prospects. He said that they had generated 157,000 more units, but the cost of coal and water was £600 less. The report was adopted.

South Metropolitan Electric Light and Power Co., Ltd.

The directors' report for the year ended December 31st, 1906, states that the revenue account shows a credit balance of £24,119, which with £1,939 the profit on the sale to the Beckenham U.D.C. and £7,748 the balance brought forward, makes a total of £33,806. After deducting £9,025 for interest on debenture stock paid and accrued, and for other interest, and £4,129 for interim dividend paid on the 7 per cent. cumulative preference shares, there remains a balance of £20,652, which the directors recommend be dealt with as follows:—Final dividend to December 31st, 1906, upon the 7 per cent cum. pref. shares, £4,129; to depreciation account, £5,000; to preliminary expenses, £1,419; to dividend upon the ordinary shares at the rate of 2½ per cent. per annum, £3,000; balance carried forward, £7,104. The business of the company continues to make steady progress, as will be seen by the following comparative figures:—

Year.	8-c.p. (35-watt) lamps. Connected at end of year.	Increase.	Number of consumers.	Gross Revenue.	Expenditure.	Net Revenue.
1903	60,540	15,624	1,734	£19,450 1 10	£8,409 0 0	£11,041
1904*	108,391	47,851	2,555	£28,796 16 6	£12,222 0 3	£16,575
1905	125,674	17,283	2,858	£35,421 13 11	£13,290 4 7	£22,131
1906	144,712	19,038	3,201	£38,244 13 6	£14,125 15 10	£24,119

* Including Crystal Palace Co.'s area from June 16th, 1904.

The net revenue account has been adversely affected to the extent of about £1,500 by an accident which occurred at the Greenwich generating station on December 20th last. The reinstatement of the damaged buildings and plant is now practically complete. The total damage is estimated at about £5,000, for which a claim will be made against the parties responsible. The new power house is expected to be in operation next month, when the company will, by more economical production, be able to deal with the increasing demand for power and supply of energy in bulk. Provision has been made to extend the present plant of two 1,500-kw. turbo-generators by an additional two 3,500-kw. machines as required. The above plant will then complete the first portion of a power house designed for a normal capacity of 30,000 kw. The London electric lighting companies are applying for powers in the present Session of Parliament to make agreements for mutual assistance and for the supply of energy in bulk to and for taking energy from one another; and an extraordinary general meeting will be convened in due course to consider the Bill.

Dividend warrants will be posted on Wednesday 27th inst. The meeting is to be held on that day at Winchester House, E.C.

W. T. Henley's Telegraph Works Co., Ltd.—Subject to audit, the directors recommend a dividend on the ordinary shares of 15 per cent. (less income-tax), for the year ending December 31st, 1906, less the interim dividend of 5 per cent. paid on September 1st last. The dividend for 1905 was at the same rate.

City of Carlisle Electric Tramways Co., Ltd.—The directors' annual report for the year ended December 31st, 1906, states that the revenue account shows a surplus of £1,903, being a decrease of £443, as compared with last year; and the balance of profit and loss account, after providing for debenture stock interest and debenture stock trustees' remuneration, is £583, which the directors recommend shall be carried forward. The car-miles run in the period have been 350,417; the number of passengers carried 2,790,699; and the total receipts amounted to £10,254 being increases of 21,709 miles run, 49,353 passengers carried, and £135 in receipts, respectively. The revenue account shows £9,600 traffic receipts; £398 parcel receipts; and other smaller items making a gross income of £10,254. On the expenditure side there are: To electrical energy, £2,782; running expenses, £3,456; maintenance and repairs, £928; and administration and general expenses, £1,185, a total of £8,352, leaving the surplus, mentioned in the report, of £1,903.

Charing Cross, Euston and Hampstead Railway Co.—The half-yearly accounts submitted at the meeting held last Friday at Hamilton House, Victoria Embankment, E.C., show a capital expenditure for the half-year ended December, 1906, amounting to £620,706, making a total expenditure of £4,991,585. During the current half-year the expenditure is estimated to be £300,000, and in subsequent half-years, £476,414. It is announced that the railway will be opened for public traffic about June 1st next.

Giant's Causeway Electric Tramway Co.—The report for 1906 states that the receipts have increased from £3,376 in 1905 to £4,179 in 1906, and the number of passengers from 128,549 to 140,191. The electric plant, generators, insulators, and wires have been overhauled, but notwithstanding increased items of expenditure, the net profits remain practically the same as in the previous year, the figures being £1,783 for 1905 and £1,737 for 1906. Since the introduction of the overhead electric system in 1899, the net profits, which only amounted to £502 in 1898, increased to £914 in 1899, to £1,263 in 1902, to £1,479 in 1904 and to £1,737 in 1906. From these profits the directors have paid 4 per cent. on £24,050 of debenture stock and mortgage, and have reduced the outstanding debit on net revenue account from £1,455 to £797. The engineer's report states that the number of miles run by electricity was 28,784, at a working cost of 4½d. per mile, and the number of miles run by steam was 9,227, at a working cost of 1s. 3½d. per mile.

Mather & Platt, Ltd.—The report for the half-year ended December 31st last shows a net profit, after charging depreciation, of £50,273, plus the balance brought forward of £25,107. The directors now recommend a dividend at the rate of 7 per cent. per annum on the ordinary shares for the half-year to December 31st last and a bonus at 1½ per cent. for the half-year, transfering to reserve account (bringing up the amount to £300,000) £30,000, leaving to be carried forward, £15,380. Mr. Hardman A. Earle and Mr. Colin Mather have resigned their office as directors; the board have elected Mr. Alan E. L. Chorlton to fill one vacancy.

Electric Supply Corporation, Ltd.—At an extraordinary meeting held at Salisbury House on 18th inst., the resolutions passed on January 31st approving the company's Bill were confirmed.

Mid-Cheshire Electric Supply Co.—The directors have declared a dividend of 3½ per cent. for the past year.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling-day in:—

London Electrobus Co., Ltd.—46,841 shares of £1 each, fully and partly (10s.) paid, Nos. 1 to 46,841.

And to allow the following to be quoted in the Official List:—

Bournemouth and Poole Electricity Supply Co., Ltd.—Further issue of 7,500 6 per cent. cumulative second preference shares of £10 each, fully paid, Nos. 40,001 to 47,500.

Yorkshire (West Riding) Electric Tramways Co., Ltd.—The report for 1906 states that the operations, after providing for all expenses, including repairs and renewals, resulted in a net income of £19,892. Adding the balance brought forward, £1,306, the available profit is £21,199. Debenture interest (less income-tax) absorbs £11,756; reserve for depreciation and renewals, £5,000; and there is carried forward £4,443. The passengers carried during the year numbered 6,169,148, and the miles run were 1,414,767, as against 5,003,637 and 1,271,030 respectively for the previous year. The tramways from Normanton to Pontefract, through Castleford, covering 7·9 route miles, were opened on October 29th, and the company has only benefited by the receipts from this section for two months.

Prospectus.—*Bahia Tramway, Light and Power Co.*—Subscriptions have this week been invited for $2,804,400 5 per cent. first mortgage debentures at 90½ per cent.

Telegraph Construction and Maintenance Co.—The directors in their report for 1906 show a net profit of £62,777, after charging the interest on the debentures. To this sum must be added £103,760 brought forward. From this amount is deducted the interim dividend of 5 per cent, amounting to £22,410, leaving £ 49,128 to be dealt with. The directors propose to distribute a dividend of £1 4s. per share, absorbing £44,820, being at the rate of 10 per cent., and making, with the amount already paid, a total dividend for the year of £1 16s. per share, or 15 per cent., free of income-tax, leaving £104,308 to be carried forward.

MARKET QUOTATIONS.

Wednesday, February 20th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a ,, ,, ,, ..	per ton	£20	..
a Bleaching powder	per ton	£5 10	..
a Bisulphide of Carbon	per ton	£18	..
a Borax	per ton	£15	..
a Copper Sulphate	per ton	£32 10	..
a Lead, Nitrate	per ton	£34 10	..
a ,, White Sugar..	per ton	£35	..
a ,, Peroxide	per ton	£32	..
a Methylated Spirit	per gal.	2/6	..
a Potassium Bichromate, in casks	per lb.	5½d.	..
a Potash, Caustic (75/80 %) ..	per ton	£20	..
a ,, Chlorate	per lb.	3½d.	..
a ,, Perchlorate	per lb.	9d.	..
a Potassium Cyanide	per lb.	7½d.	..
a Shellac	per cwt.	220/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a ,, Recovered	per ton	£6 10	..
a ,, Lump	per ton	£5	..
a ,, Caustic (white 70 %) ..	per ton	£10 15	..
a Soda, Chlorate	per lb.	3½d.	..
a ,, Crystals	per ton	£8 5	..
a Sodium Bichromate, casks ..	per lb.	3d.	..
a ,, Cyanide (basis 100 %) ..	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£200	..
b ,, Wire, in ton lots ..	per ton	£220	..
b ,, Sheet, in ton lots ..	per ton	£210	..
b Babbitt's metal ingots	per ton	£61 to £203	..
p Brass (rolled metal 2" to 12") basis	per lb.	11½d.	..
c ,, Tube (brazed)	per lb.	1/0½	..
c ,, (solid drawn).. ..	per lb.	11½d.	..
c ,, Wire, basis	per lb.	11½d.	..
c Copper Tubes (brazed)	per lb.	1/2½	..
c ,, (solid drawn)	per ton	1/2½	..
g Copper Bars (best selected) ..	per ton	£124	..
g Copper Sheet	per ton	£124	..
g ,, Rod	per ton	£117	..
e ,, (Electrolytic) Bars ..	per ton	£126	..
e ,, ,, Sheets ..	per ton	£124	..
e ,, ,, Rod	per ton	1/2¼	..
e ,, ,, H.C. Wire ..	per lb.	8/8	..
e ,, ,, ...	per lb.	8/-	..
f Ebonite Rod	per lb.	1/9	..
f ,, Sheet	per lb.	6/- to 7/-	..
n German Silver Wire	per lb.	5/1 to 5/1½	..
h Gutta-percha, fine	per lb.	£18	1/7 dec.
h India-rubber, Para fine	per lb.	55/6	..
i Iron, Charcoal Sheets	per ton	From £11	..
i ,, Pig (Cleveland warrants) ..	per ton	47/6 to 50/-	..
i ,, Forgings, according to size	per ton	£9 15	..
i ,, Scrap, heavy	per ton	{£19 15 to £19 17 6}	2/6 dec.
i ,, Wire, galvanised No. 8 ..	per ton	{£21 5 to £21 7 6}	2/6 dec.
g Lead, English Ingot	per ton	8/	..
g ,, Sheet	per ton	£7	..
m Manganin Wire No. 28	per lb.	6d. to 1/-	..
g Mercury	per bot.	2/6 to 4/-	..
d Mica (in original cases) small ..	per lb.	4/6 to 8/6	..
d ,, ,, ,, medium	per lb.	1/4½ to 1/6½	..
d ,, ,, ,, large ..	per lb.	1/5½ to 1/6½	..
p Phosphor Bronze, plain castings	per lb.	1/6 to 1/10	..
p ,, rolled bars & rods	per lb.	150/-	..
p ,, ,, strip & sheet	per lb.	1/8½	..
p Platinum	per oz.	£58	..
o Silicium Bronze Wire	per lb.	£15 to £40	..
t Steel, Magnet, acc'd'g to desc'p'n	per ton	{£193 to £194}	£2 dec.
,, ,, in bars		2/4	..
g Tin, Block (English)	per ton	£61 to £85	..
n ,, Wire, Nos. 1 to 16	per lb.	£30 15	..
p White Anti-friction Metals—			
"White Ant" brand	per ton		
k Zinc, Sh't (Vieille Montagne bnd.)	per ton		

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Teleg. Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.

STOCKS AND SHARES.

Tuesday Evening.

More than a month has elapsed since the last reduction in the Bank Rate took place, and still there is no indication of another fall. Indeed, some of the authorities in Lombard Street speak of the chances being in favour of the 5 per cent. minimum lasting for several weeks longer. From this direction, therefore, investment markets obtain no assistance, and the volume of business is setting towards speculative investments more than to gilt-edged securities.

Home Railway stocks are lamentably weak. Central Londons are all *ex.* dividend, the Ordinary and Preferred 2 points and the Deferred 4 points. But the latter stock has dropped no less than 7 to 58½, and the Ordinary is 3 down at 74—the dividend accounts for 2 of this. The longest worm, of course, has a turning, and one of these days the public will start purchases of Central London Deferred, though of this there is no present sign whatever. City and South London has fallen 1 to 44.

The most noticeable stock in the Home Railway market is London and Brighton Deferred, which fell from 115 to 102 *ex* 5 points dividends. Proprietors must pray for the swift electrification of the part of the line which is to be altered; the loss of traffic goes on increasing steadily every week.

News of an American being appointed general manager to the Underground Electric Railways of London has produced no fluctuations in the prices of the stocks. Districts are 16½. Bakerloo Debenture at 94½, Piccadilly Debenture at 89½, and Charing Cross Debenture at 86½, have not altered to any extent for some time past. Metropolitan Consolidated slumped to 44½.

British Electric Traction Ordinary shares are ⅛ down, to 3¼, and the Preference at 7⅜ are *ex* 6s. There is a rather unkind joke which says that the Ordinary are still *cum.* dividend. Calcutta Trams have begun to harden up again, both old and new Ordinary adding ⅛ to their prices. The Argentine division is steady, with barely a change worth noticing. London United Preference fell ¼ to 8¼, and the Debenture stock a point to 89½: both are getting nearer their intrinsic value now. There is 1/16 fall in Metropolitan Electric Tramways Ordinary shares. Dublin United and Potteries Preference are *ex* dividend.

Dividend announcements affect the Electricity Supply market but little in either direction. This week the tone is slightly harder, but movements are few. The most noteworthy are the rises of ⅛ in Edmundson's Ordinary and ¼ in the Preference. After the sustained fall in each class, this rally should carry an unusual amount of comfort. Metropolitans recovered the 5s. lost a week ago, and the other fluctuations are small declines caused by the dividend markings. The Westminster's report was regarded with some favour from the progress of which it tells, but it also contains a very strong hint of the fight with the London County Council which the metropolitan companies have still to face. The Preference are ½ lower at 5⅜. The Notting Hill report is quite a good one, and the Kensington and Knightsbridge is reasonably satisfactory.

Why Anglo-American Telegraph Deferred stock should have been put down to 21½ (after falling to 21⅛) is a mystery which nobody can quite understand. This is a drop of 3½ in a fortnight, or 5¼, allowing for the deducted 35s. dividend. Hundreds of thousands of stock, pawned, it is said, have been flung upon a market not eager to take more upon its book after the rapid advance in the price, and both the Stock Exchange members declared defaulters the other day had commitments open for the rise in this stock. Anglo Ordinary and Preferred are a trifle down in sympathy. Great Northern shares fell £1 to 37½ and Commercial Cable Debentures 1½ to 96, but the general steadiness of the market finds a commentary in the advance of 2s. 6d. in Globe Ordinary, to 10¾. Marconi's are down again, to 1⅜ this time, and the market is a dull one at that.

National Telephone Deferred at 111 is ½ down, and Oriental Preference at 1 3/16 are 1/16 easier.

A fall of 3 in British Westinghouse Debenture brought the price to 69. Brush shares have not moved. Henley's rose ¼ upon the dividend of 10 per cent., making 15 per cent. for the year. Cromptons hardened to 2¼, and Telegraph Constructions at 33 are £1 higher.

Scarborough Electric Supply Co., Ltd. — The directors' report for the year 1906 states that the amount of energy supplied to the Scarborough Tramway Co. was slightly in excess of that supplied in 1905. The receipts for energy supplied for lighting suffered from bad trade, empty houses in the town, and also from the reduction in the charges, which came into effect on January 1st, 1906. The capital outlay during the year had been £3,427, as against £4,636 in 1905. The accounts showed that, after placing £500 to the depreciation account, there was a balance on the revenue account of £4,537. The directors recommend that a dividend be paid, free of income-tax, at the rate of 4½ per cent. for the year, which will absorb £4,365, leaving £172 to be carried forward.

New Office.—Messrs. Dick, Kerr & Co., Ltd., have recently opened an office at Royal Chambers, Park Place, Cardiff.

Central Electric Supply Co., Ltd.—The directors' report for 1906 shows that energy has been supplied to the St. James' and Pall Mall Electric Light Co., Ltd., and the Westminster Electric Supply Corporation, Ltd., throughout the year, to an amount of 11,329,960 units. After making a full allowance for sinking fund and depreciation, and taking into account the amount brought forward from 1905, the balance of net revenue account to be carried forward is £5 18s. 8d.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Class or Share. †	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations Feb. 12th.	Closing Quotations Feb. 19th.	Business done week ended Feb. 19th, 1907. Highest	Lowest.	Rise + or Fall −	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	8 — 8½	8 — 8½	62/6	..	..	Nil
149 600	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	5 %	5 %	88 — 91	88 — 91	..	..	..	5 9 11
660,660	Anglo-American Telegraph	Stock	61s.	2½%	3½%	3½%	66 — 68	64 — 66 xd	65½	64½	..	5 17 5
3,169 670	Do. do. do. 6 % Pref.	Stock	6 %	5½%	6 %	6 %	111 —112	109 —110 xd	112	109	..	5 9 1
3,169,670	Do. do. do. Deferred	Stock	2s.	Nil	½%	1½%	23½— 23¾	21⅞— 27⅜xd	24¾	20½	..	8 0 11
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	..	5 %	..	101 —103	101 —103	..	..	..	4 17 1
44,000	Chili Telephone, Nos. 1 to 44,000	5	7 %	8 %	8 %	..	6⅞— 7¼	6⅞— 7¼	..	..	..	5 10 4
2,097,680	Commercial Cable Siing. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	96½— 98½	94½— 96½	96	..	−2	4 2 11
16,000	Cuba Telegraph	10	0 %	5 %	5 %	..	8⅞— 8⅞	8½— 8⅝	..	..	— ⅛	5 14 3
6,000	Do. 10 % Pref.	10	15 %	10 %	10 %	..	17 — 18	17 — 18	17	..	..	5 11 1
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	..	8⅞— 8⅞	8⅞— 8⅞	..	..	..	5 8 6
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	..	9 — 9½	9 — 9½	9½	..	..	5 5 2
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
80,7101	Direct United States Cable	20	8 %	8½%	4½%	..	15½— 16	15½— 16	15½	15½	..	5 6 3
60,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200,R.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	..	137 —142	137 —142	141½	138½	..	4 18 7
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	..	86 — 88	86 — 88	87½	86	..	3 14 7
1,996,716	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	..	106 —108	106 —108	106½	106½	..	3 14 1
400,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	..	13½— 14	13½— 14	13⅞	13⅝	..	5 0 0
759,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	105 —107	105½—107½	106½	..	+ ½	3 14 5
295,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..	3 19 3
400,0002	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
151 127	Globe Telegraph and Trust	10	5½%	5½%	5½%	..	10⅜— 10⅞	10½— 11	10⅛	10⅛	+ ⅛	5 0 0
151,127	Do. do. 6 % Pref	10	6 %	6 %	6 %	..	14 — 14½	14 — 14½	14⅜	..	..	4 2 9
150,000	Great Northern Telegraph, of Copenhagen ..	10	15 %	4 %	24%	..	37½— 39½	36½— 38½	38¼	37¼	−1	6 9 9
33,000	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1 5 8 4
17,000	Indo-European Telegraph	25	10 %	18 %	13 %	..	58 — 60	58 — 60	..	..	..	
216,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	⅛— ⅜	⅜— ⅞	..	..	— 1/16	Nil
72,620	Monte Video Telephone Co., Ltd. Ord.	1	8 %	4 %	5 %	..	1 — 1⅛	1 — 1⅛	..	..	..	4 8 11
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	1⅜— 1 15/32	2⅜— 1 15/32	19/9	19/4½	..	4 16 5
2 225 000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	109 —111	109 —111	111	109¾	..	5 8 1
2,225 000	Do. do. Def. Stock	100	5 %	5 %	5 %	5½%	110¾—112½	110 - 112	111¾	110⅜	— ⅜	4 18 3
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	11½ - 13½	11½ - 13½	..	..	..	4 8 11
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	5 %	10⅜ - 12⅜	10⅜ - 12⅜	..	..	..	4 0 0
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅜— 5¾	5½— 5¾	5½	5¼	..	4 5 1
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	97 — 99	57 — 99	97½	..	..	3 10 8
1,669,558	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	100 —102	100 —102	102	101½	..	3 18 5
172,318	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6¼%	6¼%	7½%	..	1⅝— 1⅞	1⅝— 1⅞	..	..	..	5 4 4
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	..	1½— 1⅝	1½— 1½	..	..	— 1/16	4 16 0
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	4 %	4 %	96½ - 98½	96½ - 98½	..	..	..	4 1 3
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
11,8899	Reuter's	8	5 %	5 %	5 %	..	7⅞— 8	7⅞— 8	7⅞	..	..	5 0 0
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	4½%	4½%	97 —102	99 —102	..	..	..	4 8 3
5,167	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	126 —129	126 —129	..	..	..	4 13 0
60,000	United River Plate Telephone	5	8 %	8 %	8 %	..	6⅜— 7⅛	6⅜— 7⅛	6⅞	..	..	5 10 4
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	..	4⅛— 5⅜	5⅛— 5⅜	..	..	..	4 11 11
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	109 —112	109 —112	..	..	..	4 9 3
18,599	West African Telegraph, Shares	10	4 %	4½%	4 %	..	10 — 10½	10 — 10½	..	..	..	3 16 2
80,668	W. Coast of America, 1 to 80,000 & 55,001 to 58,668	2½	Nil	Nil	Nil	..	⅜— ½	⅜— ½	..	..	..	Nil
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
207,580	Western Telegraph, Ltd., Nos. 1 to 207,580 ..	10	7 %	7 %	7 %	..	13⅜— 14½	13⅜— 14½	18⅞	13¾	..	4 18 3
80,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	101 —104	102 —105	..	..	+1	3 16 2
85,821	West India and Panama Telegraph	10	Nil	Nil	Nil	..	0— 1⅛	0— 1⅛	11/3	..	..	Nil
54,663	Do. do. 6 % Cum. 1st Pref.	10	7 %*	6 %	5 %	..	⅞— 1⅛	⅞— 1⅛	..	..	..	6 13 4
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	..	5⅜— 6¼	5⅜— 6¼	..	..	..	Nil
80,0004	Do. do. 5 % Debs., Nos. 1 to 1,600	100	5 %	5 %	5 %	5 %	99 —102	99 —102	..	..	..	4 18 0

Including arrears.

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, Nos. 260,008 to 510,007, and 560,008 to 580,007	..	..	8 %	8 %	..	7⅞— 8⅛	7⅞— 8⅛	8⅛	7⅛	..	4 18 6
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	5½%	5⅜%	5½%	5½%	5⅞— 6⅛	5⅞ — 6⅛	5½	..	..	4 9 10
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	125 —128	130 —128	..	..	..	4 6 11
286,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	104 —107	104 —107	106½	106½	..	4 13 6
880,000	Babcock & Wilcox, 1 to 880,000	1	17 %	20 %	20 %	..	3⅝— 4⅛	3⅝— 4⅛	..	..	..	4 14 0
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	..	1⅛— 1⅜	1⅛— 1⅜	..	..	..	3 15 7
88,000	British Aluminium, Ord., 2,001 to 40,000	5	..	7 %	7 %	..	5⅜— 6	5⅜— 6	5⅛	5⅛	..	5 16 8
40,000	Do. do. 7 % Cum. Pref...	5	Nil	7 %	7 %	..	6¼— 6⅜	6¼— 6⅜	6¼	..	..	5 3 8
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	6 %	6 %	..	5 — 5½xd	5 — 5½	..	..	..	5 4 4
20,000	Do. do. 4 % Funding Certs.	5	..	4 %	4 %	..	4 — 4¼	4 — 4¼	..	..	..	4 8 11
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	..	101 —105	101 —105	..	..	..	4 15 3
800,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	5½%	98 —101 xd	98 —101	..	..	..	5 8 11
400,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	6 %	..	131 —136	131 —136	135	134	..	4 8 3
400,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	..	114 —118	114 —118	..	..	..	4 4 9
300,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	107 —111	107 —111	108½	107¾	..	4 10 1
238,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	102 —105	100 —103	102	100	−2	4 7 5
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
188,801	British Electric Traction	10	6 %	6 %	8 %	..	3⅛— 3⅜	3 — 3⅛	67/6	62/6	— ⅛	8 11 5
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	..	7⅛— 7⅜	7⅛— 7⅜xd	7⅜	7	..	7 16 10
1,148,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	..	106 —109	106 —109	107½	..	..	4 11 9
110,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	4½%	4½%	..	84 — 87	84 — 87	86	85	..	5 3 6
100,000	British Insulated and Helsby Cables	5	8 %	8 %	8 %	..	6¾— 7	6¾— 7	..	..	..	5 14 3
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	..	5¾— 6 xd	5¾— 6	..	..	..	5 0 0
600,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	..	94 — 98	94 — 98	..	..	..	4 11 10
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	6 %	Nil	Nil	..	1⅛— 1⅜	1⅛— 1⅜	23/9	..	..	Nil
1,016,858	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	70 — 74	67 — 71	..	..	−3	5 12 8
50,000	¶ Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	⅝— ¾	⅝— ¾	..	..	..	Nil
50,000	¶ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,781	Brush Electrical Engineering, Ord., 1 to 105,781 ..	2	Nil	Nil	2½%	..	1⅝— 1⅞	1⅝— 1⅞	..	..	..	4 15 3
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	..	1½— 2	1½— 2	..	..	..	6 0 0
125,000	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	95 — 97	95 — 97	..	..	..	4 12 9
125,000	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	80 — 83	80 — 83	..	..	..	5 8 5
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	8 %	4 %	3 %	..	4 — 4⅜	4 — 4⅜	85/-	81/1½	+ 1/16	3 6 8
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	..	5¼— 5⅜	5⅜— 5⅜	5⅜	..	..	5 11 8
27,500	Do "B" do. 1 to 27,500	5	6 %	6 %	6 %	..	5 — 5½	5 — 5½	5⅜	5⅛	..	5 14 3
18,200	Do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	104 —106	104 —106	..	..	..	4 14 4
190,000	Do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	101 —104	101 —104	..	..	..	4 16 2
105,000	Calcutta Trams., 1 to 105,000	5	6 %	8 %	8 %	..	8 — 8⅜	8⅛— 8⅜	..	..	+ ⅛	4 12 9
82,610	Do. 105,001 to 187,610	5	..	..	8 %	..	7⅜— 8⅛	7⅜— 8⅛	8⅛	8⅛	+ ⅛	4 15 6
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,330	5	..	..	..	5 %	5¼— 5¾	5¼— 5¾	5⅝	..	..	4 6 11
850,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..	4 4 11
85,000	Callender's Cable Construction shares	5	12½%	12½%	15%	..	9½— 10½	9½— 10½	..	..	..	7 3 0
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	5½— 5¾	5½— 5¾	5¾	..	..	4 6 11
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	106 —108	106 —108	..	..	..	4 3 4
491,229	Cape E. Trams., 1 to 491,229	1	10 %	5 %	Nil	..	1/16— 1/8	1/16— 1/8	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	4 %	6 %	..	1⅛— 1⅜	1⅛— 1⅜	22/9	..	..	5 1 1
224,988	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	..	97 —102 xd	97 —102	..	..	..	4 8 3
911,568	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	76 — 78	73 — 75 xd	77⅜	73½	..	5 6 8
544,216	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	96 — 98	94 — 96 xd	95½	94	..	4 3 4
544,216	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	64 — 67	57 — 60 xd	65	57	..	4 13 4
1,250,000	City and South London Railway	Stock	3½%	3½%	1¾%	2½%	44 — 46 xd	43 — 45	45	44	−1	4 14 5
85,000	Crompton & Co., Nos. 1 to 85,000	8	2½%	2½%	2½%	..	2 — 2¼	2⅛ - 2⅜	48/9	..	+ ⅛	3 4 6
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 200 of £100 and 201 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	95 — 98	95 — 98	..	..	..	5 2 0

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated, all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued)*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Feb. 12th.	Closing Quotations Feb. 19th.	Business done week ended Feb. 19th, 1907.		Rise + or Fall—	Present Yield per cent.
		†	1903.	1904.	1905.	1906.			Highest	Lowest.		£ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	10 %	10 %	..	1⅞ — 1¹⅞	1⅞ — 1¹⅞	..	..	..	5 18 6
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000 ..	1	6 %	6 %	6 %	..	1¹⅛ — 1¹⅛	1¹⅛ — 1¹⅛	..	..	..	5 1 1
294,150	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
60,000	Dublin United Trams. (1896), 1 to 60,000 ..	10	5⅓%	6 %	6 %	..	14 — 15	13⅔ — 14⅔ xd	..	..	..	4 1 4
59,987	Do. 6% Pref. between 1 and 60,000	10	6 %	6 %	6 %	..	14 — 15	13¼ — 14⅓ xd	..	..	..	4 1 4
99,361	Edison & Swan Utd., "A" shrs., £3 pd., 1 to 99,361	5	Nil	2½%	4⅓%	..	1¼ — 1½	1¼ — 1½	26/3	25/7½	..	9 5 0
17,189	Do. "A" shares, 01—017,189 ..	5	Nil	2½%	4⅓%	..	2¼ — 2⅜	2¼ — 2⅜	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	85 — 87	85 — 87	..	..	..	4 14 0
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..	5 5 3
114,100	Electric Construction 1 to 114,100	2	4 %	Nil	Nil	..	⅜ — 7/16	⅜ — 7/16	..	..	..	Nil
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	7 %	7 %	7 %	..	1¾ — 2	1¾ — 2	..	..	..	7 0 0
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	81 — 84	81 — 84	..	..	..	4 15 3
25,000	General Electric Co. (1900), 5 % Cum. Pref. ..	10	5 %	5 %	5 %	5 %	8/16 — 1⅜	8/16 — 1⅜	..	..	..	5 2 4
200,000	Do. do. 4 % Mort. Deb. ..	Stock	4 %	4 %	4 %	4 %	94 — 97	94 — 97	..	..	..	4 2 6
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	3 %	4 %	4 %	4 %	3½ — 3⅝	3½ — 3⅝ xd	..	..	..	11 18 9
96,000	Greenwood & Batley 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10½ — 10⅝	10⅜ — 10⅝	..	..	..	6 10 3
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103	102 —103	..	..	..	4 17 1
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15 %	15 %	11½ — 12½	11⅝ — 12⅝	12 5/16	11 13/16	+ ⅛	5 17 8
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 5/16 — 5 9/16	5 5/16 — 5 9/16	..	..	..	4 0 11
150,000	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	107 —109	107 —109	107	..	..	4 2 7
50,000	India-Rubber, Gutta-Percha & Telegraph Works..	10	10%	5 %	10%	10 %	15½ — 16½	15⅝ — 16⅝	16	15 7/8	..	6 3 1
37,500	†Liverpool Overhead Railway, Ord.	10	1⅝%	1¼%	Nil	Nil	1¼ — 1⅜	1¼ — 1⅜	..	..	..	Nil
10,000	† Do. do. Pref. £10 paid ..	10	5 %	5 %	5 %	5 %	6 — 7	6⅜ — 6⅞ xd	..	..	..	7 8 2
600,070	London United Trams (1901), 1 to 50,007 ..	10	8 %	6 %	8 %	..	7 — 8	7 — 8	..	..	..	8 15 6
899,930	Do. do. 60,008 to 100,000 (£8 paid) ..	10	8 %	6 %	8 %	..	5 — 5½	5 — 5⅝	..	..	..	5 2 2
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000 ..	10	5 %	5 %	5 %	5 %	8 — 9	7⅞ — 8⅛	8⅛	8	— ⅛	6 1 3
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	88 — 91	87 — 90	88	87¾	—1	4 9 11
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	..	3/32 — 5/32	1/16 — 3/16	..	..	— 1/16	Nil
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	..	1/16 — 1	..	..	..	..	5 0 0
850,000	Do. 4½ % Deb. Stock Red.	100	..	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
30,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 50,000	5	..	6 %	6 %	6 %	4⅜—4⅝	4⅜— 4⅝	..	..	..	6 10 8
24,500	Potteries E. Trc., 20,001 to 40,000 & 50,001 to 54,500	10	5 %	5 %	4 %	..	6 — 7	6 — 7	..	..	..	5 14 4
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	5 %	5 %	5 %	..	7 — 8	6⅞ — 7⅞ xd	7 1/16	..	..	6 9 0
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	..	98½—101½	98⅜—101⅜	..	..	..	4 8 8
37,850	Telegraph Construction and Maintenance ..	12	30 %	15 %	15 %	15 %	31 — 33	32 — 34	32½	..	+1	5 4 4
150,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..	3 17 8
599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	5 %	5 %	5 %	83 — 85	83 — 85	..	..	..	5 17 8
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	3 %	Nil	Nil	..	1½ — 2	1½ — 2	40/-	36/3	..	Nil
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	Nil	Nil	..	3½ — 4	3½ — 4	77/6	73/9	..	Nil
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	77 — 82	77 — 82	..	..	..	4 17 7

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	5 %	5⅓%	5⅓%	..	5 — 5½	5 — 5½	..	..	..	5 0 0
70,000	Do. do. 4½ % 1st. deb. stock ..	100	4½%	4½%	4½%	4½%	99 —101	99 —101	99¾	..	..	4 9 0
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 30,000	5	10 %	10 %	10 %	..	8 — 9	8 — 9	8	..	..	5 11 1
10,502	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	..	7⅜ — 8	7⅜ — 8	..	..	..	4 7 6
336,876	Central Electric Supply 4 % Guar. Deb. Stock ..	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..	3 17 8
80,000	Charing Cross and Strand Electricity Supply ..	5	8 %	8 %	5 %	..	3¾ — 4¼	3¾ — 4¼	77/6	73/9	..	5 17 8
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	..	4 — 4½	3⅞ — 4⅜ xd	..	..	..	5 2 10
80,000	Do. "City Undertaking" 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	3½ — 4	3¾ — 4	..	..	..	5 12 6
427,400	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
49,436	Chelsea Electricity Supply, Ord.	5	5⅓%	6 %	6 %	4⅓%	4⅜ — 4¾	4⅜ — 5¼	..	..	..	4 5 9
175,000‡	Do. do. 4½ % Deb. Stock Red. ..	Stock	4½%	4½%	4½%	4½%	104 —107	104 —107	..	..	..	4 4 1
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	6 %	6 %	6 %	9¼ — 10⅛	9⅜ — 10⅜	10 3/16	10	..	5 14 3
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11⅝ — 12⅝	11⅝ — 12⅝	..	..	..	4 16 0
400,000‡	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	121 —124	121 —124	..	..	..	4 0 8
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
40,000	County of Durham Electrical Power, Ord. ..	4	4 %	£8 7 0	4 %	..	3½ — 4⅜	3½ — 4⅜	..	..	..	3 16 2
50,000	Do. do. do. 5 % Pref. ..	5	5 %	5 %	5 %	..	4⅜ — 4¾	4⅜ — 5¼	..	..	..	4 15 3
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4½%	5 %	..	8¾ — 9¼	8¾ — 9¼	8⅝	8⅜	..	5 8 1
40,000	Do. do. 6 % Pref., 40,001—80,000	10	6 %	6 %	6 %	..	10⅝ — 11⅛	10⅝ — 11⅛	..	..	..	5 4 4
400,000‡	Do. do. 4½ % Deb. Stock ..	..	4½%	4½%	4½%	4½%	105 —108	105 —108	..	..	..	4 3 4
400,000	Do. do. 4½ % 2nd Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	98 —101	98 —101	99	98⅜	..	4 9 1
80,000	Edmundson's Electric Corporation, Ord. Shares ..	5	7 %	7 %	4 %	..	2 — 2¼	2⅛ — 2⅜	45/-	43/9	+ ⅛	8 8 5
80,000	Do. do. 6 % Cum. Pref... ..	5	6 %	6 %	6 %	..	3⅞ — 4¼	4 — 4⅛	85/-	80/-	+ ⅛	6 13 4
350,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	93 — 96	93 — 96	93	..	..	4 13 9
10,000	Folkestone, 1 to 10,000	5	5⅓%	5⅓%	5⅓%	..	5⅝ — 5⅞	5⅝ — 5⅞	..	..	..	4 17 9
10,000	Do. 5 % Cum. Pref., 1 to 10,000 ..	5	..	..	5 %	..	5 — 5⅛	5 — 5⅛	..	..	..	4 15 3
90,000	Do. 4½ % 1st. Deb. Stock	100	4½%	4½%	4½%	4½%	97 —100 xd	97 —100	..	..	..	4 10 0
18,000	Hove, 1 to 18,000	5	8½%	8½%	9 %	..	7⅛ — 8	7⅜ — 8	..	..	..	5 12 6
21,000	Kensington and Knightsbridge Electric Ord. ..	5	12%	12 %	10 %	10 %	9½ — 10⅜	9½ — 10⅜	..	..	..	4 17 7
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	97 —100 xd	97 —100	..	..	..	4 0 0
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	3 %	4 %	4 %	2 — 2⅛	2 — 2⅛	48/9	46/3	..	4 17 0
70,000	Do. do. do. 6 % Pref...	5	6 %	6 %	6 %	6 %	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	3 14 3
674,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4½%	95 — 98	95 — 98	..	..	..	4 11 10
200,000	Metropolitan Electric Supply, 1 to 100,000 ..	5	8⅓%	10 %	10 %	..	6⅞ — 7⅜	7 — 8	7⅜	..	+ ⅛	6 5 0
76,121	Do. 4½ % Cum. Pref. 1—71,106 ..	5	4½%	4½%	4½%	4½%	5⅝ — 5⅞	5⅝ — 5⅞	..	..	..	4 3 9
220,000‡	Do. 4½ % 1st Mort. Deben. Stock ..	..	4½%	4½%	4½%	4½%	106 —110	106 —110	..	..	..	4 1 10
250,000‡	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	91 — 94	91 — 94	..	..	..	3 13 10
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
67,991	Newcastle-on-Tyne	5	8 %	8 %	8 %	..	7⅞ — 8	7⅞ — 8	..	..	..	5 0 0
75,000	Do. 5 % Pref., 1 to 75,000	5	5%	5 %	5 %	..	5⅝ — 6⅛	5⅝ — 6⅛	..	..	..	4 1 8
10,852	Notting Hill Electric Lighting	10	6 %	7 %	7½%	7½%	12½ — 13½	12½ — 13½	..	..	..	5 11 1
64,000	Do. do. 4 % 1st Mort.Deb... ..	100	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
20,000	Oxford, 1 to 96 and 407 to 20,310	5	6⅔%	7 %	7 %	7 %	6 — 6½	6 — 6⅓	6⅓	..	..	5 7 8
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	96 — 98	96 — 98	..	..	..	4 1 8
40,000	St. James' and Pall Mall Electric Light, Ord. ..	5	14½%	14½%	12½%	10 %	8¼ — 9⅜	8⅛ — 9⅛ xd	..	..	..	5 8 1
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	7 — 8	6⅞ — 7⅞ xd	..	..	..	4 19 4
150,000‡	Do. do. 3½ % Deb. Stock Red. ..	100	3½%	3½%	3½%	3½%	93 — 95	93 — 95	..	..	..	3 13 8
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	4 %	Nil	1 — 2	1 — 2	..	..	..	Nil
60,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	71 — 75 xd	71 — 75	..	..	..	5 6 8
65,000	South London Electricity Supply, Ord.	5	8 %	4 %	4 %	3 %	2½ — 3	2⅝ — 3	..	..	..	6 13 4
120,000	South Met. Elec. Lt. & Power, Ord..	1	Nil	Nil	2½%	2½%	2⅝ — 3	2⅝ — 3	..	..	..	3 6 8
117,968	Do. do. 7 % Pref... ..	1	7 %	7 %	7 %	7 %	1⅝ — 1¾	1⅝ — 1¾	..	..	..	5 1 10
200,000	Do. Do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	2⅞ — 3⅜	2⅞ — 3⅜	..	..	..	6 13 4
80,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	3½ — 4¼	3½ — 4¼	82/6	..	..	5 17 8
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	4½%	4½%	..	99 —102	99 —102	..	..	..	4 8 3
110,000	Westminster Electric Supply, Ord.	5	18¼%	14 %	18 %	12 %	9⅛ — 10⅛	9⅛ — 10⅛	9⅝	..	..	5 17 1
81,279	Do do. 4½ % Cum. Pref. ..	5	5 %	5 %	5 %	4½%	5⅛ — 5⅜	5⅛ — 5⅜	5 1/16	5⅛	— ⅛	4 7 10
	(Originally 5%—Red. to 4½ % from 31st Dec., 1905.											

Shares not officially quoted:—Mackay Companies, ord., 76—78 + 1. Pref. 72—74 — 4.

† Unless otherwise stated all shares are fully paid. § Interim dividends.

Bank rate of discount 5 per cent. January 17th, 1907.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING JANUARY, 1907.

The returns of electrical business for the month of January compare favourably with those for the last month of the year just closed.

The exports of electrical goods at £150,251 are some £2,000 in excess of the December figures, while the imports show a considerable increase, totalling £154,384, as against £137,250 in the preceding month. The re-exports, which in December dropped to a comparatively low value, in January reached a total of £16,027.

These values are well above the averages obtaining during the 12 months of 1906, which were, approximately, 134, 13, and 147 thousands respectively for exports, re-exports and imports, and far above those of the preceding year, 1905.

Turning to the exports individually, the machinery sections show considerable improvement over the December values, but cable exports show a falling-off of some £10,000; further, no export of tramway material was recorded during the month.

The imports, on the other hand, show reduced values for machinery entering this country, but increased cable entries, to the extent of some £15,000 worth.

Telephonic supplies, usually a large item in the imports, include some £17,000 worth from Belgium, and are appreciably greater in value than in December. It may also be noted that the re-exports from this country include some £6,400 of telephone material.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.*

Country receiving exports and importing.	Electrical goods and appliances.	Electrical cable.	Electric lighting fittings and accessories.	Electric lamps.	Electric meters and instruments.	Electric machinery.	Batteries and accumulators.	Carbons.	Telegraph and telephone material, and electric bells.	Electrically-driven machinery	Tramways apparatus and materials.
	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark	978	957	282	26	15	241	...	...	5	12	...
Germany and German East Africa	219	398	101	12	42	3,371	25	...	...	...	...
Netherlands	39	1,339	390	44	...	1,335	...	...	...	102	...
Belgium	150	14	57	...	189	1,205	...	...	388	...	...
France and French Indo-China	181	...	24	...	10	511	2	...	...	...	...
Portugal, Madeira and Portuguese Africa ...	592	2	102	63	51	587	13	...	366	...	...
Spain and Canary Isles	195	86	119	34	...	227	3	...	...	...	...
Italy, Austria-Hungary and Turkey	109	276	127	7	429	428	...	...	...	30	...
Egypt	52	8	101	126	...	1,232	128	...	5	48	...
China and Siam	158	1,084	1,362	51	134	794	132	20	871	2,237	...
Japan	267	8,772	31	...	2,749	6,616	...	...	...	3,817	...
U.S.A. and Philippines	362	12	23	721	97	681	75	...	7	...	...
Mexico, Gautemala, Colombia, Peru and Uruguay	232	4,270	...	221	...	402	...	...	29	3,740	...
Chili	963	466	84	355	...	720	195	3	57	1,535	...
Brazil	560	15	357	38	232	1,160	...	75	18	1,347	...
Argentine	2,455	3,060	764	591	55	2,797	499	26	511	2,495	...
Channel Isles, Gibraltar and Malta	399	270	752	17	...	1,289	5	...	30	440	...
British West Africa and St. Helena	109	91	10	...	9	989	...	...	37	...	...
Cape of Good Hope	2,037	3,467	456	283	167	1,959	140	2	...	290	...
Natal	1,578	4,246	665	415	448	727	...	...	668	27	...
Aden	...	...	...	...	...	...	...	...	59	...	...
India	4,512	3,581	1,088	787	475	9,966	165	208	44	929	...
Burmah	597	350	491	127	67	457	162	...	2	...	...
Ceylon	88	8	131	33	9	...	38	...	20	...	...
Straits Settlements, Sarawak and Labuan ...	250	304	205	123	230	483	17	4	17	179	...
Hong Kong	195	77	48	15	...	...	16	...	5	...	...
West Australia	621	27	185	237	60	2,509	...	...	...	...	...
South Australia	356	...	171	32	...	383	52	...	50	...	...
Victoria	415	497	44	76	27	1,081	...	...	123	32	...
New South Wales	1,264	2,835	93	640	174	3,790	215	13	163	475	...
Queensland	216	149	208	61	...	184	71	...	...	...	...
Tasmania	2	...	...	...	...	67	...	...	...	...	...
New Zealand	247	1,247	243	14	270	1,786	55	...	32	...	...
Canada	115	176	35	152	8	...	...	...	43	...	...
British West Indies, British Guiana, British Honduras and Bermudas	23	30	53	33	2	105	...	...	...	...	...
Total, £	20,536	38,104	8,802	5,334	5,949	47,882	2,008	351	3,550	17,735	...

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

	£	£	£	£	£	£	£	£	£	£	£
Norway, Sweden and Denmark	30	244	...	40	...	1,747	152	...	5,542	...	...
Holland	809	3,508	1,122	9,963	63	1,194	237	5,411	694	...	...
Germany	2,875	24,951	258	1,328	45	9,350	405	1,417	1,294	...	...
Belgium	553	6,052	112	7,284	145	3,095	445	1,375	17,062	852	...
France	281	5,570	3,061	137	1,111	1,455	863	3,425	3,004	160	...
United States	3,146	355	453	384	266	15,948	34	214	1,906	2,358	...
Canada	...	...	...	...	...	109	...	...	...	...	...
Total, £	7,694	40,680	5,006	19,136	1,630	32,898	2,136	11,842	29,502	3,370	...

Additional Imports: Victoria and New South Wales, electric machinery, £90; Italy, cable, £400.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

	£	£	£	£	£	£	£	£	£	£	£
Various countries, mainly as above	3,278	714	3,186	480	52	1,177	98	274	6,377	396	...

Total Exports: £150,251

Total Re-Exports: £16,027

Total Imports: £154,384

Note.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns.

* This section does not include telegraph cables and apparatus.

PROCEEDINGS OF INSTITUTIONS.

Investigations on Light Standards and the Present Condition of the High-Voltage Glow Lamp.

By Clifford C. Paterson, A.M.I.E.E.

(*Abstract of Paper read before the* Institution of Electrical Engineers, *London, January 24th*, 1907.)

It is now generally appreciated that atmospheric conditions have an important influence on the candle-power of flame standards.

In a photometer room the principal variations to which air is liable are the following:—

1. Variation in the amount of carbon dioxide.
2. Variation in the amount of water vapour.
3. Variation in the proportion of oxygen and nitrogen.
4. Changes in barometric pressure.

Before any measurements with flame standards can be considered reliable, it must be ascertained that the air is under standard atmospheric conditions, at least as regards 2, 3 and 4. If the conditions be abnormal, the amount of water vapour in the air as well as the barometric pressure must be known.

Extended investigations have been made by the author on the Harcourt 10-candle pentane lamp. This is the standard of the Metropolitan Gas Referees, and has been adopted at the National Physical Laboratory as being the most convenient unit of light.

The influence of carbon dioxide on the candle-power of flame standards may be considered, for practical purposes, as negligible.

The amount of water vapour in the air is the most disturbing factor to be considered, as it cannot be remedied by ventilation of the photometer room. There are large natural variations in humidity throughout the year, and rapid changes from day to day.

The following formula connects candle-power and humidity for the 10-c.p. lamp:—

$$\text{Candle-power} = 10 - 0{\cdot}066\,(10 - \epsilon)$$

where ϵ is the number of litres of water vapour per cubic metre of dry air. It will be observed from this formula that the candle-power of the lamp has its standard value when the volume of water vapour is 10 litres. This figure represents very nearly indeed the mean humidity over the three years 1897-8-9, both at the Meteorological Office and at the National Physical Laboratory. The average monthly humidities range from 7 to 14, corresponding to errors of about plus or minus 2 per cent. in candle-power. Individual observations are liable to twice this error.

The formula obtained for the Hefner lamp is—

$$\text{Candle-power (pentane units)} = 0{\cdot}914 + 0{\cdot}005\,(8{\cdot}8 - \epsilon).$$

Experiments made with two Carcel lamps show that the Carcel lamp cannot be relied upon for constancy to the same extent as the other lamps.

In the case of a 10-c.p. pentane lamp, no measurements should be relied upon which have been made after the lamp has been burning in a closed room for more than 15 or 20 minutes.

Suppose that the lamp is being used in a room in which the ventilation is bad, and causes, say, a drop of 1·5 per cent. in the candle-power of the lamp. If the day be hot and damp and the barometer low, the 10-candle lamp will be giving a light of the order of 9·2 candles, and the Hefner lamp under the same conditions will be only slightly more accurate.

The formulæ for expressing candle-power variations due to barometric changes are as follows:—

$$\text{Pentane lamp: Candle-power} = 10 - 0{\cdot}008\,(760 - b).$$
$$\text{Hefner lamp: Candle-power} = 0{\cdot}914 - 0{\cdot}0001\,(760 - b).$$

Pentane units.

The author has not as yet found any photometer which, for the same coloured light, is equal in sensitiveness and accuracy to the Lummer Brodhun contrast apparatus, which has been used in all the experiments described in this paper.

In terms of the 10-candle Harcourt pentane lamp,

Hefner lamp = 0·914 pentane units.
Carcel lamp = 0·982 pentane units.

The pentane lamp has a whiter light than the Hefner unit, and the fact that its candle-power is 11 times that of the amyl acetate lamp makes it of the same order of magnitude as the ordinary lights which are tested against it.

These two factors, coupled with the greater ease of adjustment when making observations with the pentane lamp, greatly outweigh, in the author's opinion, the disadvantage of the more complicated construction and the larger correction that has to be applied for changes in barometric pressure.

The author, from several years' experience with large-bulb Fleming Ediswan lamps as laboratory standards, can testify to their reliability when ordinary precautions are taken in using them.

Ten of these lamps were obtained two years ago from the Ediswan Co. for use as laboratory standards. They were mounted on fixed sockets with soldered leads, and run for periods varying from 400 to 600 hours on a circuit the pressure of which was carefully regulated. Candle-power readings were taken at frequent intervals during the run. The curves of typical lamps are shown in fig. 1. The efficiency of these lamps was initially about 4·5 watts per candle, and 4·3 after 500 hours. When compared with the life curves of ordinary lamps, it will be noticed over what a long period the initial rise in candle-power lasts. The best curve is that of lamp 15, which remained constant for 200 hours. In the case of lamp 11, there is no sign after 600 hours of any diminution in the rapid rate at which the candle-power is rising.

The performance of filaments specially prepared for constancy cannot be predicted with certainty. If a lamp is to be used as a photometric standard of the first grade, its history for 100 to 200 hours should be known, and its life curve should be closely watched in order to ascertain the point at which it is beginning to flatten out.

A properly aged specially prepared low-voltage filament, if burnt for, say, 10 minutes a day for five days in the week, should last two

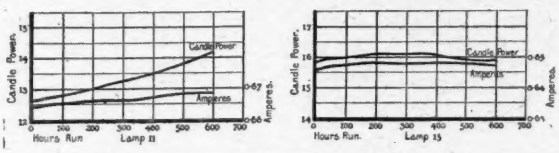


Fig. 1.—Life Curves of Large-Bulb 100-Volt Fleming-Ediswan Electric Standards.

or three years without changing ½ per cent. in candle-power, provided that no excess voltage is applied.

Where, however, the only source of supply is a high-voltage variable circuit, it is essential that the standard and the test lamp shall be run in parallel, so that the effect of voltage variations may be reduced to a minimum.

Six lamp makers kindly undertook to co-operate with the Laboratory in the investigations, by supplying high-voltage 16-c.p. lamps, with filaments which they considered would be most suitable for standard purposes. The filaments were in one plane and the bulbs of ample dimensions. The lamps numbered in all 37, and were run on a pressure-regulated circuit with frequent observations of candle-power and current.

Sample curves are shown in fig. 2 (see next page); as the efficiency of the various sets was different, the curves can only be considered as roughly comparable.

As a result of these investigations there is no doubt that high-voltage lamps are to be obtained which remain constant for a considerable time. They cannot, however, as yet be produced with certainty. By trying a number of special lamps, some may be found which are in every way as good as low-voltage standards—but at present the only alternative to this is to select a lamp with as small and as regular a drop as possible, and rely on restandardisation after about 20 hours' running. It should not be necessary to run a standard under ordinary conditions for longer than 45 minutes per week in all. In this case restandardisation would only be required every six months.

The Engineering Standards Committee has kindly given the author permission to publish the results of some tests which have been carried out for it at the National Physical Laboratory on 120 high-voltage glow lamps. These were made by ten British makers and were bought over the counter in the ordinary way. The lamps were tested for mean horizontal candle-power and watts at the marked voltage, and the results plotted on target diagrams, some of which are shown in fig. 3. In fig. 4 is shown a set

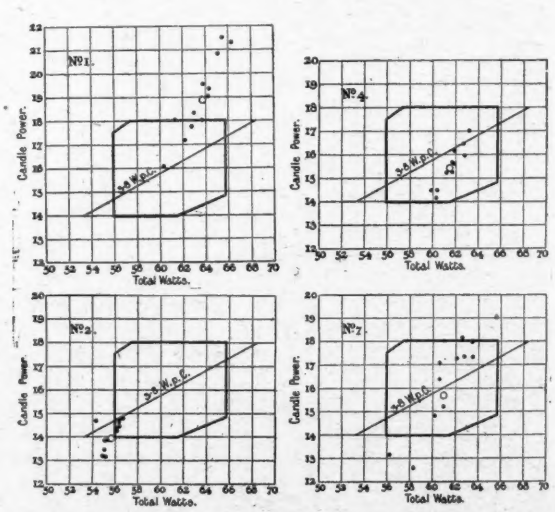


Fig. 3.—Diagrams Showing Initial Rating, British 200-volt 16-c.p. Glow Lamps.

typical of American Edison 200-volt lamps bought in the open market; the limits shown are those within which lamps must fall in order to meet the requirements of the American markets, whilst those shown by the six-sided figure in the centre of each diagram for the English lamps are the individual limits which would be allowed by the Standards Committee's specification for 3·8-watt lamps. The large circle in the centre of each diagram represents the mean of all the lamps.

A cursory inspection and comparison of the diagrams in figs. 3 and 4 brings out many points of interest regarding the uniform

rating of lamps. In batch 7 the candle-power, nominally 16, varies, not unevenly, over a range from 11 to 18, the corresponding efficiencies being from 5·2 to 3·4 watts per candle, and the "useful life" at the marked voltage varying, probably, from 2,500 hours in the case of the inefficient lamp, to 230 in the case of the efficient one. In group 2, on the contrary, although the candle-power is uniformly low, the limits are within 13 and 15 candles, and the useful life at the marked voltage would lie, approximately, between the narrow limits of 340 and 650 hours

These wide variations leave much to be desired.

It is rightly urged in extenuation of this condition of things that the very unequal grading of supply voltages in this country renders it impossible for makers to supply lamps at a reasonable price which shall fall within the same narrow limits that are imposed under the American system. It is not possible in lamp manufacture to predict, even within fairly wide limits, what will be the voltage at which a lamp will give a certain candle-power and consume a specified number of watts per candle. There must, therefore, of necessity be a considerable number of lamps which would be more suitable for, say, 215, and others for 225 volts, which are, nevertheless, rated for 220 volts, because of the small demand for lamps

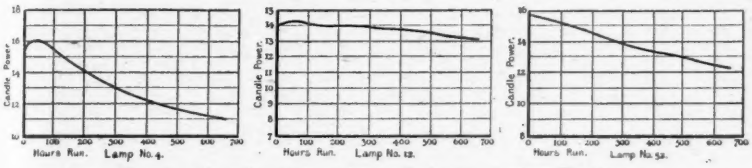


Fig. 2.—Life Curves of High-Voltage Carbon Filament Standard Lamps.

for the odd pressures, and the natural desire to keep down the number of outfalls to a minimum. But even taking this into consideration the fact that some English makers are able to turn out a much more uniform product than others, shows that improvement would be possible if the large buyers of lamps insisted on having them supplied to specification, and took proper steps to see that they did not fall short of the guarantees.

If the American + and — limits were applied to the average of each batch of these English lamps, about 45 per cent. of them would be rejected; whilst if they were applied on the assumption that the average candle-power was to be 16, only 35 per cent. of the lamps would pass the test. Even the wider limits specified by the Engineering Standards Committee would, under these circumstances, exclude 40 per cent. of all the lamps.

The maintenance of candle-power on life—or, in other words, the number of useful candle-hours obtained from a lamp—is the chief point about which information is required when buying lamps.

The diagrams shown in fig. 5 illustrate the state of things at the present day in this country as regards the performance of glow lamps on life test. Six out of each make of lamp which came nearest the mean were selected for life test, and run under identical conditions. The voltage on each was so adjusted that the

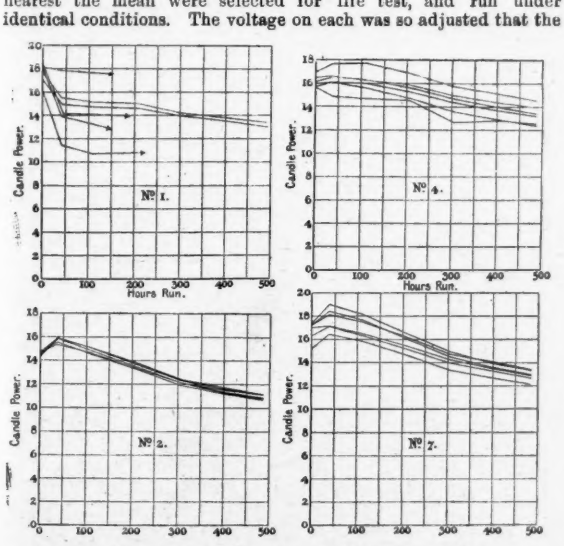


Fig. 5.—Individual Life Curves of British 200-volt 16-c.p. Glow Lamps.

watts per candle at the commencement of its life were exactly 3·8. The test was considered at an end when the candle-power of the lamps had fallen to 80 per cent. of the initial value.

Fig. 5 shows the performance on life test of individual lamps. The useful life obtained from the different groups varies between the limits of 150 and 550 hours. In view of the great difference in quality which the results show to exist between different makes of filament, the desirability of some form of life test becomes apparent, in order to prove the reality of lamp guarantees.

The author found the average ratio of M.S.C.P.: M.H.C.P. to be about 0·865 for the various filaments tested.

Five lamps being taken from each consignment, and being run on life test at definite initial watts per candle, in six cases out of nine the probable error is under 1 per cent., whilst the maximum probable error is 1·3 per cent.; so that in practically all the tests made in this way results may be relied upon to within 2 per cent.

The cost of power in such cases, worked out on the basis of five lamps tested for life out of a consignment of, say, 1,000, comes to 0·36d. per lamp. This is reckoning that the current, being specially regulated, will cost 3d. per unit.

The test usually has to be made by arranging a short length of resistance wire in series with each lamp. Run under these con-

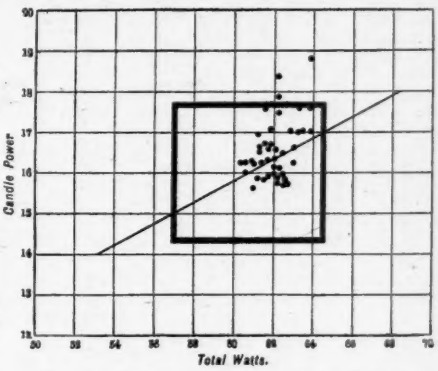


Fig. 4.—American 200-Volt Glow Lamps.

ditions the pressure across the lamp terminals will not be more than 1 or 2 volts above or below the normal.

The system adopted at the Electrical Testing Laboratories of New York is to adjust the voltage initially on each lamp so that it is burning at its standard candle-power. The method ensures that the 16-candle lamp, for instance, has the advantage of the full amount of drop from 16 to 12·8 candles before its useful life is considered at an end. The disadvantage is that on the life test it may be running at slightly above or below the correct watts per candle. The author prefers the method adopted by the Engineering Standards Committee of having the watts per candle rigorously correct. Lamps should then be chosen for the life test which are nearest to the standard candle-power. In practice, however, the difference between the two methods amounts to very little.

Good voltage regulation during the life test is of vital importance. If the pressure fluctuates about a mean value, an excess voltage for a given time will not, as regards the life of the lamp, be fully balanced by a corresponding diminution in pressure for the same time. Fluctuations in pressure should, therefore, be kept to within + or — ½ per cent. The accurate setting of the mean voltage is also of great importance, since it is not always appreciated that with ordinary glow lamps an increase of only 0·2 per cent. in the volts produces a variation of 1 per cent. in the life.

About two years ago a series of tests was carried out at the National Physical Laboratory on behalf of one of the Government Departments, in order to determine if it were possible by an over-running test to predict the percentage drop which lamps would have after a given time if run under ordinary conditions. Lamps were ordered on a specification which entailed a life test for one hour at 40 per cent. increased voltage.

The results showed that from the point of view of maintenance of candle-power this test on a lamp cannot be regarded as a certain guide to its behaviour at normal voltage. This conclusion only applies to such an excessive over-running as 40 per cent. in volts, corresponding to about 1·3 watts per candle.

For the measurement of mean spherical candle-power there was no apparatus at the Laboratory for taking spherical candle-power observations in one reading, and it was at first found necessary to use a point by point method.

The laborious nature of these tests led the author to try the accuracy, by actual measurement, of a method for determining mean spherical candle-power originated by Mr. Alex. Russell, who was the first to point out that by selecting the correct angles in the vertical plane, the accuracy of the result would not be appreciably diminished if the sphere were considered divided up into considerably fewer zones, thus greatly reducing the number of observations necessary.

It was found that the error introduced by taking 4 instead of 20 readings is only 2 per cent., and by taking 6 instead of 20 is only 1 per cent.

In conclusion, the author wishes to emphasise the importance both of accurate photometry and accurate electrical adjustments in connection with the rating and testing of glow lamps. The specification recently issued by the Engineering Standards Committee provides a sound basis upon which glow lamps may be bought and tested, but it is essential, in view of the sensitiveness of the glow lamp to small changes in pressure, that all measurements under it shall be conducted with a maximum degree of accuracy.

The waste of money per annum in this country due to using unsuitable lamps must be very great, and the only way to stop the waste is to encourage those manufacturers who rate their lamps properly and who give an effective guarantee of their quality. It should further be noted that, in order to obtain all the advantages accruing from the accurate rating of glow lamps, it is essential that

supply engineers should regulate the voltage at the consumers' terminals within the narrowest possible limits.

In connection with these tests the author desires specially to acknowledge the obligation he is under to Dr. Glazebrook, director of the National Physical Laboratory, and chairman of the Sub-Committee on Physical Standards which has been engaged in the work of drawing up the glow-lamp specification. He also wishes to thank Mr. Rayner for his ready assistance and advice, and to acknowledge his indebtedness to Mr. Selby and other members of the Laboratory staff for their counsel and help.

Discussion.

Dr. Fleming, in opening the discussion, referred to flame standards, the vagaries of which did not particularly trouble the gas people, who tested flame against flame. We had not yet accounted for variations in the standard due to the number of people in the test room. The decay in candle-power in electric lamps was due to carbon deposit and, therefore, the large bulb was best; and a properly built large lamp was better than any flame standard, as there were no corrections to apply. He had aimed to get a constant candle-power in his standard lamps for over 700 hours (excepting the first few hours), and he thought the author's tests to some extent confirmed this. On account of the small change of candle-power compared with time, numerous tests could be made with only slight error.

Mr. C. J. Robertson thought the new specification would tend to keep unknown lamps out. From the makers' point of view, the carbon lamp was the more suitable standard, and it would be of advantage if all lamps could have large bulbs. The new specification would produce, theoretically, better lamps, but standardisation of pressure was necessary in order to get good results. English lamps were much better generally than American, but the English maker must have graded voltages of supply, in order to get rid of outfalls. He concluded by pointing out the superiority of carbon over metals for filament making.

Mr. Alex. Russel, commenting on flame standards, pointed out that the Carcel lamp was very good in its day; it was brought out eight years before Murdock's tallow candle.

Mr. Lancelot Wild suggested that the dimensions, and particularly the height of the photometer room, would affect the pentane standard; this might account for the variations between Westminster and Bushy tests. He preferred to rate lamps by the maximum rather than the mean horizontal candle-power; the reduction factor he had found to be ·802 to ·825. But, he asked, why not test the mean spherical candle-power right away when testing lamps? He could not see the utility of measuring the useful life of a lamp and saying it was of no use when it had fallen to 80 per cent. A 1 per cent. error in the last moment would produce a 10 per cent. error in life. In testing two lamps for mean horizontal candle-power, a variation in the reduction factor would greatly vary the life; but testing for mean hemispherical candle-power there would be no difference in the lives of the lamps.

Mr. Haydn Harrison remarked that in the author's paper 19 pages were devoted to the troubles of the flame standards; he hoped the latter would not long survive, as one could not breathe without affecting them. The metal filament seemed an ideal standard; given length of wire, section and current, you should get a certain light.

Mr. Vernon Harcourt, in a communication, pointed out that both atmospheric and temperature effects on flame standards were well known.

Prof. Ayrton took exception to the idea that the number of useful candle-power-hours obtained was the chief point when buying lamps; what was important was the useful life plus the amount of energy consumed during the period. The cost of lamp renewals was nothing, compared to the cost of energy. In regard to the flame standards, he asked if the standards tested in the various countries were the same lamp or different lamps made to the same specification, also how was the quality of the pentane determined. The Board of Trade in 1895 had presented a 10-c.p. pentane flame standard for the use of the London Gas Companies; this was ·4 per cent. greater than the official Physical Laboratory standards. He considered the author's present tests confirmed his own experience of poor results with 200-volt lamps, and did not bear out the excellent results obtained with 8-c.p. 200-volt lamps, when tested by Prof. Kennedy at the time the London circuits were changed over to 200 volts. He went on to refer to the excellent results obtained with silicon-carbide filaments in 1896 at the Premier Lamp Works, Liverpool; 1·3 watts per candle-power efficiency had been obtained, but difficulties were met with in manufacture, and it was given up on account of the difficulty in meeting the wide pressure variations in the local circuits.

Mr. A. P. Trotter said that the Hefner unit was the legal standard in Germany; the Board of Trade standard was an official standard, but only legal in the sense that it was used for the London Gas Commission. He pointed out that the Hefner unit was very nearly adopted at the Chicago meeting; it was an excellent standard and very cheap. The Fleming lamp was excellent as a secondary standard, but it required hosts of subsidiary apparatus.

Mr. W. R. Cooper, referring to the pentane standard, asked how a fair sample of atmosphere was ensured? He thought the author's tests were (with good reason) made from the manufacturers' point of view rather than the consumers, *i.e.*, the filament was considered rather than the lamp.

Mr. C. Wilson thought it strange that makers were always asked to grade lamps, when regulation of pressures would meet the case. He showed some pressure charts of a nominal 200-volt circuit, which varied from 196 to 216 volts during lamp-burning hours; and remarked on the unfairness of blaming the maker of 200-volt lamps for their bad behaviour on such a circuit. He knew a case where the engineer ordered lamps of 226, 228, 230 and 232 volts pressure for his circuit. American lamps were no better than English, but they had graded pressures, and so disposed of what were outfalls here. He actually supplied lamps suitable for under or overrun circuits if he knew those conditions to exist, but such lamps, of course, tested badly at their nominal voltage.

Mr. Wigham complained of the lack of uniformity of lamps. His company were distributing free lamps, and their tests showed 8 c.p. lamps giving between 5½ and 10 c.p., and many breaking down under 200 hours. He thought the blackening of the bulb was a good index of the life of the lamp.

Mr. Paterson, in briefly replying, said that, probably, many people wanted lamps tested under actual running conditions, but he thought the consumer wanted to know whether the lamps he was buying were high grade ones as the latter would give good results under varying conditions. It was not possible to specify what a lamp would do if run at its marked voltage, because the efficiencies of lamps in a batch varied.

Suction Gas Engines and Gas Plants.

By Hugh Campbell, M.I.M.E., A.M.I.E.E.

(*Abstract of Paper read before the* Institution of Electrical Engineers *at Leeds, January 24th*, 1907.)

In a paper which I read before the Institution two years ago, I gave the actual capital and working costs of a steam-driven and a gas-driven station, both stations being of exactly the same size and capacity, and under the same management, so that each afforded a fair comparative test as to the economy of each system of working. I give in the table below the working costs of these stations; there is practically 45 per cent. economy in the working of the gas-driven station over that of the steam driven station.

The figures have been supplied to me by the engineer and manager of the Guernsey electricity supply, Mr. Arthur G. Bird.

TABLE I.

—	1905.		Jan. to March, 1906.	
	Steam plant. Lighting load. Per unit generated.	Gas plant. Power load. Per unit generated.	Steam plant. Lighting load. Per unit generated.	Gas plant. Power load. Per unit generated.
Coal, including steam and air pumps, and forced draught, at steam station	·436	·200	·391	·151
Oil, waste, water, stores	·037	·042	·027	·046
Wages	·214	·133	·209	·136
Average hours of attendance per day	18	13	—	—
Repairs (buildings, machinery, transformers, main accumulators)	·250	·123	·207	·176
Total works costs	·937	·498	·834	·509
Units generated	500,490	718,858	164,323	162,438
Average per cent. of full load	68½ %	86½ %	—	—
Coal used per unit generated	4·97 lb.	2·21 lb.	—	—
Price of coal in bunkers—washed anthracite peas	16s. 2d.	15s. 6d.	16s. 2d.	15s. 6d.

My firm have installed at Broxburn a suction gas engine and gas plant for the electric lighting of that district; the engineer in charge of the station, Mr. G. G. Wright, has been good enough to send me the following particulars as to the cost of working for October, 1906 (29 working days):—

Total fuel consumed	6 tons 13 cwt.
Total units generated	6,917
Duration of run per day	7½ hours
Consumption of fuel per B.H.P.-hour	1·25 lb.
Cost of fuel per B.H.P.-hour	·08d.
Consumption of fuel per unit	2·09 lb.
Cost of fuel per unit	·138d.
Consumption of oil for 29 working days	10 gallons
Cost of oil per gallon	2s. 3d.
Cost of fuel in bunker	12s. per ton

Mr. Wright informs me that the whole of the above data are from ordinary working conditions during the month of October last, the producer being simply shut down at the end of the day's run and started up the following day after the gas generator fire-bars were first cleared of any ash, and the generator fire being clinkered once a week. The gas plant was standing 16½ hours out of the 24 doing nothing; the above figures include all the stand-by losses, and the engine was working only at about half-load.

Comparative cost of working a gas engine and electric motor driving blower for cupola furnace at the works of Messrs. Croft and Perkins, Bradford, 1906:—

Town gas per 1,000 cb. ft.	2s. 1d.
Cost of electricity	2d. per unit
Consumption of town gas per ton of melted metal	80 cb. ft.
Cost of town gas per ton of melted metal	2d.
Consumption of B. of T. units „	4·16
Cost of electricity „	8·32d.

The gas and electricity were supplied by the Bradford Corporation.

In Mr. Dowson's splendid book recently published on "Producer Gas," pages 164 to 171, will be found a fair and complete comparison of stand-by losses between gas plants and steam boilers.

The average of eight examples of steam boilers is 71·5 lb.; gas plant, 3·5 lb.

For a given horse-power the gas producer is much smaller and has far less radiating surface than the boiler. It has no water to be heated, and it can be worked up to its maximum production in about 15 minutes after standing almost any length of time. With a boiler there is usually a large amount of external brickwork to be heated, and there is a considerable quantity of water. When the boiler is standing the water and the brickwork lose heat, and not only more time, but more fuel is required to make up this loss, than in the case of the gas producer.

From actual experience with various sizes of suction plants, I have found that the total consumption of water is from 1½ to 2 gallons per B.H.P. per hour.

The cost of upkeep should not exceed in a well designed and constructed plant of 50-B.H.P., £3 per annum; of 100-B.H.P., £4; and of 300-B.H P., £10 per annum. The only items which can wear out are the bottom fire grate and the brick lining of the gas generator.

The gas generator body should not be made of cast-iron but of steel plate, as if made of the former metal it would sooner or later crack, owing to the expansion and contraction which goes on, and when once an air leak takes place, either in the generator body or fire-brick lining, no gas can be satisfactorily manufactured. The base of the generator shou'd be made of cast-iron, so as to resist corrosion. The lining of the generator should be of a very substantial character. The bricks, whether of fire-clay or silica, in a 100-B.H.P. plant should not be less than 8 in. thick, and a sand packing should be allowed for between the bricks and the outer shell of steel plate. The bases of the coke scrubbers should be made of cast-iron, and not of steel plate, as internal corrosion may, in the course of three or four years, destroy the ¼ in. or $\frac{5}{16}$ in. plate, of which these are usually made, but with a cast-iron base the scrubbers will withstand any corrosion which is likely to occur for an indefinite period. The capacity of the generator should be amply large enough to allow for a wide margin in the quality of the fuel consumed, and to reduce the amount of attendance required for feeding and clinkering the generator.

The capacity of the coke scrubbers for any size of plant should be such that it can be run six days per week for twelve months without the coke requiring to be renewed.

The impurity of suction gas is no greater than that of any other form of producer gas used as motive-power, and my experience of it for several years proves that there is no additional wear and tear in the engine through its use. The engine valves should not require cleaning oftener than once a month, and the piston and cylinder once in six months. The amount of lubricating oil used is no greater than if the engine worked on lighting gas. The adoption of ring lubrication to the crankshaft, camshaft and outer bearings, and of forced lubrication to the piston and cylinder, has minimised the consumption very greatly.

Like all producer gases, suction gas is poisonous and non-odourous; but as the whole plant is working slightly below atmospheric pressure, there is no possibility of escape of gas. I only know of one case of "poisoning" and one case of "gassing," and in both cases carelessness in observing the necessary precautions was the cause.

With regard to the question as to the quality of the effluent water from the coke scrubber, experience has shown that no detrimental effect has been caused by the effluent water in either sewers or streams.

Gas engine makers have found from actual experience that there is no use attempting to make their crankshafts by calculations, as stresses come upon them from time to time which are not calculable; they must be made very much larger to meet these incalculable strains and stresses, as well as to give larger bearing surfaces. White metal in gas engine bearings is not satisfactory owing to the spreading and cracking of the metal, and the true remedy is larger crankshafts providing adequate surfaces, so that the harder alloys can be used as bearings.

My experience of all three types of governing proves to me that with the "quality" or "quantity" system you obtain less cyclical variation in speed owing to the ignition at each cycle, but there is with these systems a greater variation in speed between no load and full load than with the "hit-and-miss" system.

The hit-and-miss system stands pre-eminently as the most economical system. In an engine of 100 B.H.P. when working at half-load the "quality" system will be 20 per cent., and the "quantity system" 25 per cent. less economical than the "hit-and-miss" system, and with lighter loads than half power the difference becomes greater. Taking the same size of engine running at light load the difference in economy will be 40 per cent. This is the price which one has to pay for low cyclical variation at light loads.

Experience of splash lubrication has shown us how unreliable and how expensive in oil such a system is, and we have fitted our vertical four-cylinder engine with forced lubrication throughout, in a similar manner to that used in steam engines of the enclosed type.

For continuous working with a suction plant it is always necessary that the gas generator should be in duplicate, *i.e.*, two gas generators with one set of coke scrubbers. The plant is worked with one generator at a time, and so long as it can be run without requiring to be clinkered. Before it is shut down for clinkering the duplicate generator is set going, and for a few minutes both generators are opened to the engine; after that the used generator is closed down for clinkering, and it in its turn is got ready for the next run.

Discussion.

Mr. W. Hartnell, in opening the discussion, referred to the extremely low cost of working suction gas plants, a form of motive-power destined to play a very important part in the future both in electricity stations and elsewhere. The system described was a simple and easy means of obtaining power (of moderate amount) at a much less cost than by any other method. The Airedale Clothing Co.'s works were driven and lighted by electricity, by means of a 40-H.P. gas engine, at first supplied with Leeds gas. When afterwards it was supplied from a suction gas producer, the operating cost was reduced to less than one-half. Anthracite coal used cost 24s. per ton. The cost of fuel was but a small item in the cost of power from a gas plant. At an engineer's works near Rochdale, the gas being supplied from a Mond producer, the cost of fuel per H P. was about ½d. The coal cost 8s. 6d. per ton, and came from Nottinghamshire. In estimating the cost of a power plant to a manufacturer, at least one-eighth of the capital to be sunk should be added to the annual operating and maintenance charges, for interest and depreciation. A man going into business with limited capital should study whether it would not be better to buy electrical power rather than sink capital in a private power plant that might be more advantageously used in his business.

Mr. W. Emmott said Mr. Campbell's illustrations indicated considerable improvement over their 1904 vertical engines, especially in the matter of lubrication, which he had found to be a costly item. The cost of lubrication in the Peterborough engines mentioned in the paper was only half that of Broxburn, and considerably lower than obtained at Guernsey. As to suction gas generators, he agreed that some of these on the market would only do the specified work when using the best anthracite, and were much below their rated capacity when using a cheaper fuel, and he had seen instances where it was out of the question to use coke. He ascribed this not so much to a desire to save a few pounds in manufacture, as to a want of knowledge of the elementary laws of combustion. He advocated a simple system of water pressure gauges, by which a leak of air was at once made evident and localised.

Mr. W. B. Woodhouse thought that the claims made for simplicity, cleanliness, and the small amount of space occupied by the suction gas engine plant, were very much open to question. The experience of users was not very favourable. The nauseous smell of the effluent water was a great drawback, and the plant itself was, in his opinion, very dangerous to life, so that factory inspectors would not allow it to be put into a workshop, but would insist on a separate building for it. Suction gas plants were entirely out of the question for textile work on account of the necessity of avoiding any variations in speed. Anthracite was 60 per cent. dearer in Leeds than in Guernsey. The capital cost of the gas engine installation had to be considered before one could compare with either town gas or electric motors. It was very questionable whether the suction gas plant was better than town gas at 2s. per 1,000. The extra cost of the plant, and the difficulty and necessity for having skilled labour, were all against the adoption of these plants. He was afraid that none of the methods of governing were very satisfactory. He wished they were, for he felt that it was only a matter of time before they would have to adopt them.

Mr. G. D. Seaton said that in Lancashire electricity was being dumped as low as ·35d. per unit. Mr. Campbell said the best he could do was ·487d. The power companies were quite willing to take people on at ·5d., and the Manchester Corporation would take them on at ·6d.

Mr. W. M. Rogerson said he would like to know why in Guernsey anthracite peas used for the gas plant should cost 15s. 6d. in the one case and 16s. 2d. in the other. The cost of coal per unit in Mr. Campbell's figures appeared to come out exceedingly low, the Guernsey station being only ·2d. In the case of a suction gas plant in Halifax they paid 26s. per ton for anthracite, and the cost on that plant, where every figure was put down every day and totalled up every week-end, for coal alone, came out at ·4d per KW.-hour as against Mr. Campbell's figure of ·2d.

Mr. J. D. Bailie said that he visited a great number of steel and iron works all over the country and saw a number of the larger-sized plants, but he could not say that he knew of one of these engines giving satisfaction.

Prof. Goodman mentioned a case at Grassington where a steam-driven electrical plant was installed, also a suction gas-producer; the owner of the plant was dissatisfied with the electrical plant, but he was highly pleased with the suction gas plant, which was working perfectly and used an extremely small amount of coal. The plant was worked by a quarry labourer who had had no previous experience. It was a 20-H.P. engine, and a couple of buckets of coal per day was all that was required. The repairs also were exceedingly low. There was not a shadow of a doubt that suction gas plants were very much more economical in running than steam plants.

Mr. H. Dickinson drew attention to the author's statement that the steam station was 45 per cent. less economical than the gas station. Two years ago he pointed out that the gas plant was running on a power load and the steam plant on a lighting load, and, therefore, there was no fair comparison. Not being satisfied with the figures mentioned in the paper, he wrote to Mr. Bird, at Guernsey, for fuller particulars, and mentioned that the figures were required in connection with the paper. As a result of this communication, his surmise that the two stations were not running under comparable conditions was verified, and it appeared that the steam station had to be ready to take any load from 6 o'clock in the morning until 11 o'clock at night, and the gas-engine station started at 6 o'clock in the morning and shut down at 7 o'clock at night when the batteries took any small load that might be

required. It appeared that the steam station acted as a stand-by in case of a breakdown at the gas-driven station. It was evident, therefore, that the steam station was not run under such economical conditions as the gas station.

Mr. MacLachlan said it was questionable whether it would pay to put in a suction gas producer in Leeds, as the price paid for anthracite by a firm there was something like 34s. per ton.

Mr. T. Harding Churton drew attention to the test given in Table Ia in the paper, in which the figures appeared to be taken at full load, under which conditions the cost was practically ½d. per unit generated. It would be interesting to know what actual efficiency might be expected at 50 per cent. load as compared with that at full load, and what the cost per unit would be at half load. In the case of a printing works in Leeds which had been driven by a gas engine with town gas, when a considerable part of the load was transferred to an electric motor very little difference was made in the gas consumed by the engine. The explanation was that the average power was comparatively small (though the maximum power was required intermittently) and the engine was thus working under unfavourable conditions. Any estimate of the cost of working based upon the cost of running at full load would, in such a case, be entirely fallacious. In the instance referred to, the gas engine was, after six months' comparative trial, supplanted by two electric motors worked from the supply mains, and a saving in cost was effected thereby. He had recently had occasion to make inquiries respecting engines of about 300 h.p. to drive dynamos, to utilise gas from coking plant; in his investigations he had been struck with the number of breakdowns to which such engines were subject, and he had hesitated to recommend their adoption.

Mr. R. A. Frank said that some years ago he had some experience with a producer plant of about 8 h.p., and when they wished to start it took eight or nine men to turn the engine round for perhaps two minutes to draw the producer gas in and get a firing charge. In the case of 200 h.p. plant he would like to know what method of starting was in vogue.

COST OF LIVING IN SOUTH AFRICA.*

[COMMUNICATED.]

As a continuation of the articles which have appeared in the Electrical Review on the cost of living abroad, perhaps a few particulars regarding South Africa (where engineering is so prominent), gleaned from a personal acquaintance of several years with the country, may be of interest.

It is generally understood that South Africa possesses many climates, and that the conditions prevailing in one district may be totally different from those which exist only a comparatively short distance away. This fact can perhaps be well demonstrated by remarking that while around Cape Town grapes, peaches, &c., are grown with facility in the open—in Natal coffee and pineapples, in Mozambique cotton and rubber, and in Rhodesia tobacco, &c., are largely cultivated. The contour of the land also effects changes in temperature not to be expected from merely a contemplation of the latitude. Beira, on the east coast, is some distance below the degree of latitude on which Salisbury is situated, and although only about 350 miles apart, they possess two distinct climates. In Beira the shade temperature frequently exceeds 100° F. in the summer, and is seldom less than 55° F. in the winter, but Salisbury, owing to its extreme height, frequently experiences slight frost in the latter season. It is therefore impossible to describe the conditions of South African life under one head.

Board and lodging may be obtained in Cape Town, and mostly in the whole of the south of Cape Colony, from £6 per month. It can occasionally be obtained for less than this sum, but the fare would be such as is generally partaken of by steerage passengers. Copper coins are used much less than in England. The minimum fare on the tramways is 3d., and a glass of ale costs 6d. Cape Town possesses an excellent service of electric tramways, extending some five or six miles on either side of the city, with one or two longer routes, and in view of the residential quarters being so scattered, the tramways are much more patronised for business purposes than is the case with London suburban traffic. House rent is dear, and cottages of three or four rooms will easily fetch £5 per month. Clothes are very expensive, and an ordinary suit, obtainable in England for, say, 50s., will cost 90s. upwards. Native tobacco of excellent quality can be purchased for 2s. per lb., but English brands are about 50 per cent. dearer than in England. In this connection it may be remarked that matches form a protected Colonial industry, and are both expensive and bad. In Cape Town the total cost of living need not exceed £10 per month, a sum which may be slightly reduced or largely increased according to the tastes of the individual. £10 per month should provide similar conditions to those usually obtainable in London for about £6. An average salary for superior mechanics, artisans, &c., in Cape Town and most of the Colony is about £18 per month, but owing to the severe depression, this sum has lately been much reduced, and it is now difficult to obtain any position, even when on the spot. The genuine distress which the writer has seen in South Africa has at times been very painful to contemplate.

In Natal the cost of living is slightly cheaper, and under normal circumstances the average rate of pay is a little lower. In Durban, for example, a medium class of board and lodging may be obtained at respectable boarding houses for £5 per month. The board will include three meals per day, but at this figure it is frequently necessary to share the bedroom with another boarder. The exclusive use of a bedroom, however, may usually be obtained for about £1 per month extra. The cost of clothing is about the same as in Cape Town, but as lighter clothes are necessary, on account of the warmer climate, the clothing bill may be slightly reduced.

In the Transvaal and the Orange River Colony life is much more expensive from all points of view. Indeed, as railway transport is very dear, it may be accepted, as a rule, that the further one goes from the coast so are imported necessaries increased in price. Board and lodging are not usually obtainable in Johannesburg under £8 or £9 per month, and at this price are usually of inferior quality. Rent is about £6 to £7 per month for a small house, and then the house is often inconveniently situated. In the writer's opinion a salary of £30 per month is equal to about £12 in London. If the recipient chooses, however, the latter sum may be saved from the former, but the majority, well, do not so choose.

Hours of business in all the foregoing places are much the same as in England.

Lourenço Marques (Delagoa Bay) and Beira are towns usually regarded as being very unhealthy, but this reputation, so far as the towns are concerned, is largely exaggerated. Portuguese hours of business and meals prevail. In the former case work commences at 7 or 8 a.m. and ceases about 5 with a break of 2 hours at 11 a.m. for "breakfast." Lourenço Marques possesses a good system of electric tramways (described in the Electrical Review of December 21st, 1906) and public lighting, as do most important towns in South Africa. Those people who are fond of Continental life would find Lourenço Marques far from disagreeable. Its inhabitants are largely cosmopolitan, but the Portuguese language predominates. The cost of living is about the same as in the Transvaal.

Rhodesia may, perhaps, be considered to be the most attractive country in South Africa for an engineer on account of the high salaries paid. Conditions of life are much more primitive than in the South, however, and many inconveniences have to be borne. A driver of a locomotive will usually earn between £30 and £40 per month, while the cost of board and lodging in, say, Salisbury, may be anything above £13 per month. Clothing of a heavy kind, necessary for chilly nights, is expensive, but little attention is paid to fashion compared with the southern parts. Khaki and cottons are largely used, and suits of these materials may be purchased for about 30s. The demand for engineers is very limited, and they are mostly employed on the mines. The South of Rhodesia possesses a healthy climate, and there is little to fear from sickness provided proper care is taken. In some parts, however, black-water fever is frequently found, whilst, in the northern portion of that territory, malaria is more or less abundant. The writer spent several years on the East Coast and in Rhodesia, and only suffered from one severe attack of illness. Medical treatment is expensive, and the usual fee which the writer had to pay to doctors was a guinea per visit.

In conclusion, the warning not to travel to South Africa at present in search of employment may be repeated, unless furnished with sufficient money to provide for a return

* Previous articles, &c., appeared in the Electrical Review, Vol. 59, p. 660; Vol. 59, p. 1031; and Vol. 60, p. 172.

journey or a voyage elsewhere. Indeed, most of the Colonies can refuse admission to immigrants unless provided with work in advance of arrival, or with substantial funds. Local supplies of employés are plentiful, and districts where engineers are likely to find employment are dispersed over wide areas. An engineer in Salisbury would have very little better chance of securing a vacant post in Cape Town than he would were he in England.

Nothing has been said here with respect to the cost of social amusements in South Africa. It is a most difficult subject to which to apportion any cost, and has been the stumbling-block of hundreds of young men, who have journeyed to South Africa with every prospect of a successful career, but who, having acquired extravagant and indiscreet habits, have quickly wrought their ruin. In the more remote parts of the country the principal forms of sociability are confined to public-house bars and billiard saloons, and the less these are indulged in, the greater cause will a man have to be thankful—at least from the point of view of his pocket.

NOTES ON TURBINE TROUBLES.

By G. NEVIL-THOMAS.

These notes are not written with any idea of going systematically into all the troubles to which a turbine is heir, but they cover a few of the many which have happened in the writer's knowledge.

On starting up a turbine at any time, it cannot be too emphatically impressed on those responsible, that there is a strong necessity for properly flushing the bearings either by the hand pump or the power-driven pump. The writer has seen drivers flush the bearings with a hand pump and then allow one or two minutes to elapse between doing so and getting the turbine away.

Oil should continue to be pumped not only as long as the machinery is stationary, but until the speed reaches 10 per cent. of full speed, because, if the pump is driven by gearing from the rotor, it will not perform its duty efficiently until this speed (approximately) is reached.

Quite recently a turbine which had been running was shut down for a few minutes. The driver then flushed the bearings and allowed it to stand for another two or three minutes. The machine was then got under way, and it had not been running more than a few minutes before the blades were stripped. On examination it was found that the bearings on both ends of the turbine were run out through overheating due to want of oil at the start.

Another trouble which may be taken as being one of extremely rare occurrence, is due to dirt coming over from the boilers. Even in the best cared for machinery, dirt is liable at times to come across from the boilers and make its appearance in the turbine. In many cases, however, instead of passing through the turbine and condensers into the air pump discharge, it is stopped by the blades themselves.

A small amount of dirt can not only considerably impair the efficiency of the turbine, but it can also reduce its output considerably. In addition to this, it has the effect of creating a difference of pressure between different points of the rotor, with a result that the rotor itself is continually being forced against the end thrust bearings.

In one case so considerable was this pressure that the metal on the dummy glands was turned completely off, worked its way under the spindle of the rotor, caused it to spring, and stripped five expansions on the turbine both on the stator and rotor.

Another point which, whilst repeatedly written about, engineers constantly neglect until it has been forced upon them by experience, is the fact that it is unsafe to start up a turbine until the shaft has been properly and evenly heated. If a machine has been started up without being heated, the shaft is pretty certain at the time to be bent, this bending being due to unequal temperatures in different parts.

Should the machine be started at such a time, it will be found that in certain instances, generally speaking towards the middle expansion, the blades will be touching. With an even temperature produced by warming up the turbine before starting, the shaft regains its straightness.

It is perfectly true that for months the turbine can be started continually without causing any noticeable trouble in this direction, but it is certain in course of time to cause disaster. It happens in some cases that this touching may be going on for some time without any notice being taken, or any ill result becoming prominent, but that is no reason for neglecting precautions.

Another trouble with high-speed turbine sets develops itself on the generator side.

Some manufacturers make it a practice to insulate one of the bearings on the alternator side, the reason being that, owing to the field of the rotor being magnetically out of balance, a difference of potential arises between the two ends of the shaft. If one bearing is not insulated, the circuit is closed through the two bearings of the rotor and the base of the machine. The result is an electrolytic action between the shaft of the machine and the bearings. The effects appear to be of two kinds: either the white metal is completely run out, or else the bearings remain sound and the shaft becomes badly pitted over the whole surface. This pitting is continuous and uniform, and gives the shaft the appearance of having been standing for a long period in strong acid or of the shaft having never been turned up at all.

The writer has seen the shaft coated with pit marks which must have been more than $\frac{1}{16}$ in. deep. It was so bad that it was a matter of astonishment that the bearings had not run out through over-heating. As a matter of fact, the bearings were in perfect condition.

Another source of trouble, which also is by no means peculiar to turbines, is the trouble due to bad oils. Power station engineers would find it safer to use oils recommended by manufacturers of the turbines which they, owing to the necessity of constantly experimenting and testing, have found to be most suitable for the turbine at the lowest possible cost.

Turbine oils form a very considerable item in the expenses of a station, as even a unit of, say, 1,000 H.P., may use as much as 60 gals. of oil, which, at the price of 3s. 6d. per gal., amounts to £10 to £12. The temptation, therefore, to cut down the cost price of oil is great, but, if given way to, without extreme carefulness in testing both chemically and by experimental use, will cause disaster in some form or other.

That there are numbers of other troubles in connection with turbines may be true, but each of the above has, within the writer's knowledge, cost money which might well have been saved if the knowledge had been forthcoming before, instead of after, the event.

WIRELESS TELEPHONY.

By R. A. FESSENDEN.

(*Continued from page* 253.)

General Principles of Wireless Telephony.

Speaking broadly, wireless telephony is accomplished by generating a practically continuous succession of electro-magnetic waves, receiving them on a constantly operative receiver, and modifying the character of the emitted impulses by means of sound waves without interrupting their continuity.

Apparatus for Wireless Telephony.

1. *Means for the Practically Continuous Generation of Electro-Magnetic Waves.*—At the time the writer took up this work the three methods in use were:—(*a*) The plain aerial with spark gap, used by Marconi; (*b*) the plain aerial heavily loaded with inductance, used by Lodge; (*c*) the plain aerial in conjunction with a local oscillatory circuit having a period of a different order of magnitude from the period of the antenna, used by Braun.

The writer conceived the idea of using an antenna in conjunction with a local circuit tuned to the same frequency as the aerial. This was patented by the writer (United States Patent 706,735, December 15th, 1899), and is now in general use in all wireless telegraph stations.

By the use of this circuit and an induction coil and commutator giving 10,000 sparks per second, articulate speech was transmitted over a distance of 1 mile in 1900. The articulation was, however, not as good as might be desired, and there was an extremely disagreeable, and, at times, overpowering, noise due to the irregularity of the spark.

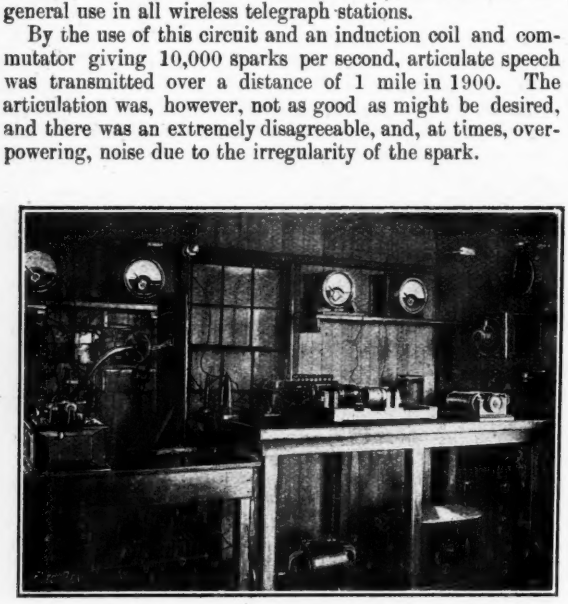


Fig. 2.—Apparatus for Transmitting from Gramaphone on the Left.

With sparks in air the best results were obtained by using a slightly convex disk of platinum-iridium for one discharge terminal and a sharp-pointed aluminium cone for the other, the terminals being so connected as to give the shortest discharge distance.

Later it was found, after the invention of the compressed gas spark-gap by the writer in 1900 (United States Patent 706,741, November 15th, 1901) that this gave a much steadier spark. The gas generally employed was nitrogen, this being most easily obtained by pumping the vessel up with compressed air and placing lime in the bottom of the chamber to absorb the nitrous acid formed by the discharge.

Later still a mercury gap of the Cooper-Hewitt type was used, but proved not quite so good as the compressed gas gap, even when the spark was localised as much as possible by small points of platinum-iridium wire projecting to the surface of the mercury. With the above types of apparatus high speed breaks of different kinds have been used.

Another method which gave fairly good results was the use of a 10,000-cycle 1-kw. alternator, giving about 10 amperes at 100 volts. This was used with an air-core transformer giving about 10,000 volts, and giving 20,000 sparks per second. With this apparatus the speech was more distinct than with 10,000 sparks, and on account of the regularity of its action it gave quite good results when used with the compressed nitrogen discharge gap. About 1903-4 it and the compressed gas gap were sufficiently in shape to justify the company in advertising wireless telephones guaranteed to distances of 25 miles.

The compressed nitrogen spark-gap is shown in fig. 5.

Another method used was a rotating spark gap attached to a rivet spindle making 500 revolutions per second and giving 20,000 sparks per second. This was used in connection with some small generators giving 5,000 volts direct current. The terminals were of 40 per cent. platinum-iridium. This gave fair but not good results, *i.e.*, speech could be transmitted, but the scratching of the spark was quite bad. This device is shown in fig. 4. In order to obtain a constant amount of energy of discharge the apparatus was arranged to charge a condenser to a definite potential and to discharge it again.

With all the above types of apparatus the radiation, while sufficiently continuous for the purpose of telephony, was not *completely* continuous. While it was found that fair articulation could be obtained with 10,000 sparks per second, there were self-evident advantages in obtaining absolutely continuous radiation. A great many methods for obtaining this were devised and tested, but only a few will be described here, particularly as it is inadvisable to disclose some of them for patent reasons.

In 1891, Elihu Thomson invented the very interesting method of producing high-frequency oscillations, commonly known as the musical arc, using a continuous-current arc shunted by a condenser and inductance in connection with a magnetic blow-out. This is shown in his United States Patent 500,630, July 18th, 1892. (See Electrical Review, December 21st, 1906, p. 986.)

For some reason, probably the curious provincialism which afflicts so many European scientists and scientific publications, this arrangement has been attributed to Duddell, though the latter never used the device until many years after the publication of Thomson and other American workers on the subject, and does not appear to have fully grasped its method of operation.

In his patent Elihu Thomson points out that frequencies as high as 50,000 or more can be obtained in this way. This has been controverted by Duddell (*Electrician*, 1903, Vol. 51, page 902), but in 1898 the writer had already experimentally demonstrated that Prof. Thomson was correct.

Experiments made in 1899 for the purpose of using Elihu Thomson's musical arc for wireless purposes developed the fact that it was not entirely satisfactory. By the use of properly cooled electrodes and an air blast and magnetic blow-out, frequencies of several hundred thousand were obtained, but it was found that neither frequency nor intensity was constant, and the fact that a key could not be used to make and break the current, since the arc would not start itself, made it impracticable in its original shape.

To overcome the last-mentioned difficulty, a method of working wirelessly was devised, in which the arc operated continuously, and emitted radiation continuously, and the signalling was done by altering the frequency of the emitted waves (see United States Patent 706,742, June 6th, 1902).

In order to overcome the former difficulty, instead of using a pure inductance in series with the arc, a coil having a considerable resistance was used, with only a moderate amount

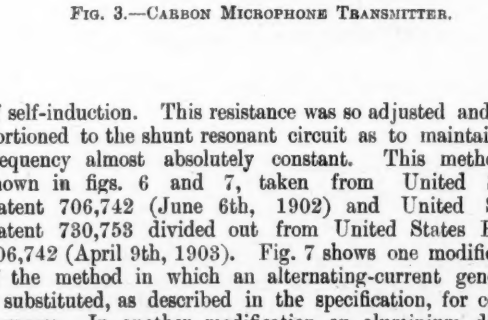


Fig. 3.—Carbon Microphone Transmitter.

of self-induction. This resistance was so adjusted and proportioned to the shunt resonant circuit as to maintain the frequency almost absolutely constant. This method is shown in figs. 6 and 7, taken from United States Patent 706,742 (June 6th, 1902) and United States Patent 730,753 divided out from United States Patent 706,742 (April 9th, 1903). Fig. 7 shows one modification of the method in which an alternating-current generator is substituted, as described in the specification, for certain purposes. In another modification an aluminium disk is used, as described by Mr. Brown.

When this method was applied to telephoning, it was found to give the same objectionable scratching and hissing in the receiver. To some extent this was overcome by the revolving contact methods shown in fig. 6. In 1901 and 1902, however, most of the work was done with the compressed nitrogen spark-gap (United States Patent 706,741, November 5th, 1901). This

gave a comparatively steady discharge—much better, in the writer's experience, than can be obtained with oxygen or any other gas at atmospheric pressure, though the writer has made some experiments on the inert gases, particularly argon, which gave good results.

Later it was found that much better results were obtained when the water-cooled electrodes were made very thin. So long as the water-cooled electrodes had an appreciable thickness, a certain amount of the electrode was carried off, and gave rise to irregularities. Taking a hint from some experiments on his magnetite arc made by Mr. Steinmetz and his assistant, Mr. Dempster, of the General Electric Co., the ends of the water-cooled electrodes were made of thin silver, $\frac{1}{100}$ths of an inch thick, which greatly improved matters. The final arrangement obtained was, as mentioned above, quite good enough for commercial work, and was advertised in 1904-5 under guarantee of operativeness. It was never, however, entirely free from scratching, though in the best form this was more disagreeable than serious.

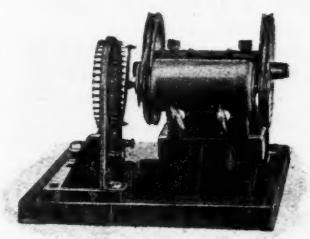


Fig. 4.—Rotating Spark Gap.

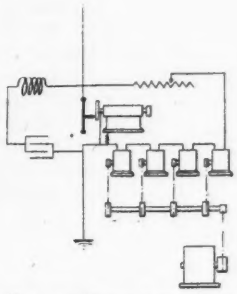


Fig. 6.—Revolving Contact Method.

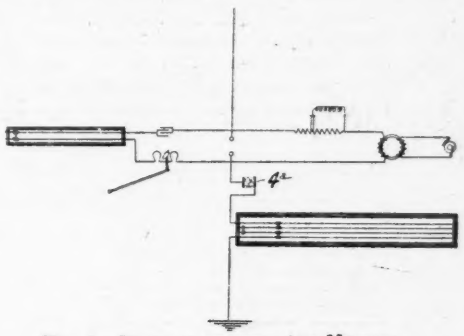


Fig. 7.—Diagram showing Arc Method of Transmission.

Meantime, work had been progressing on high-frequency alternators, with the kind assistance of several of the General Electric Co.'s engineers, more especially Prof. Steinmetz, Mr. Haskins, Mr. Alexanderson, Mr. Reist, Mr. Dempster and Mr. Geisenhoner, to which gentlemen I am indebted for the ultimately successful outcome of the work.

The alternator, which is of the general type described in United States Patent 706,737 (May 29th, 1901), but which embodies many ingenious mechanical arrangements requiring a great deal of mechanical skill for its construction, is illustrated in fig. 1 (Electrical Review, February 15th, 1907, p. 252). It was originally designed for a frequency of 100,000 cycles, at an output of 1 kw. In practice, however, pending the construction of the De Laval gear-driven type, it is never used above 80,000 cycles, on account of belt slipping, and, in fact, for most work it is run at 60,000 cycles.

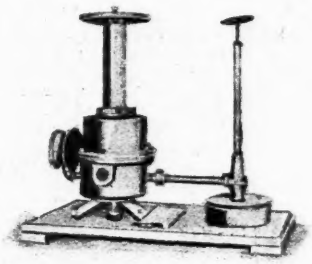


Fig. 5.—Compressed Nitrogen Spark Gap.

The resistance of the armature is approximately 6 ohms, and the inductive drop at full load is about equal to the ohmic drop. It is usually run at about 50 or 60 volts at 60,000 cycles. The armature revolves at 10,000 r.p.m., and the bearings are lubricated by oil pumps.

The operation of the machine is extremely satisfactory, it being run daily for six or seven hours at a time, with practically no attention. Great credit is due to the engineers and mechanics of the General Electric Co. for the way in which the design has been worked out.

In operation the alternator is generally connected to the aerial through a transformer. The coupling used is a tight one, as the energy falls off very rapidly when a loose coupling is used.

As a sample illustration of the method of working, the following may be given :—Telephoning from Brant Rock to Plymouth — Distance, 10 miles ; primary current, $2\frac{1}{2}$ amperes ; primary turns, 10 ; secondary turns, 700 ; primary voltage, 45 volts ; secondary voltage, approximately, 3,000 volts ; frequency, 50,000.

No capacity is generally used in the primary of the transformer, as the antenna generally acts, as I have pointed out elsewhere, as a fly-wheel, and even to some extent governs the speed of the alternator.

At the sending station in this particular experiment one of the transmitters shown in fig. 3 was placed between the aerial and ground, as shown at 4*a*, fig. 7. The resistance of the transmitter was about 8 ohms. Fig. 2 shows the general working arrangement.

At the receiving end the usual liquid barretter receiving system was used. The strength of the received speech was 25 times that of audibility, audibility being taken as that strength at which all words spoken could be clearly heard and understood. The speech could still be understood clearly when the telephone, whose resistance was 1,200 ohms, was shunted by a 40-ohm resistance box.

As it happened, in the above test, the primary of the receiving circuit was not tuned, so that the values for the intensity of received speech were considerably lower than is customary.

(To be continued.)

COMMERCIAL DEVELOPMENT OF ELECTRICITY SUPPLY.

By R. Borlase Matthews, Wh. Ex., A.M.I.C.E.

Electricity Supply Stationery Forms.

A suggestion has been made by a correspondent to the effect that it would fill a want if some printing firm made a speciality of supplying standard stationery suitable for use by electrical undertakings. The difficulty in the way of carrying out this suggestion in practice is that all such stationery has to be specially printed so as to suit local conditions and requirements ; and it is also essential that such stationery should bear the name of the undertaking. Again, very often the supply authority finds that it pays to get the printing done locally, as then the printer can more easily be persuaded to use electric power for driving his printing machines. However, as general forms that could be modified to suit local conditions would doubtless be useful, on receipt of specific inquiries, model forms arranged in accordance with recent practice will be given in these columns. A useful order form was given on page 49 of this volume—a good feature of this form being that the particulars as to the system of supply are given, a little point which, at times, saves much confusion.

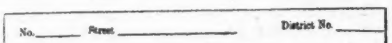
The accompanying forms will be of interest, as they are devised to facilitate systematic reports from canvassers, and so to keep a check on their work.

Income per Head of Population.

"Chelmsford" asks how the figures giving the income per head of population per annum, such as those recorded on p. 650 of the issue of the Electrical Review dated October 19th, 1906, were arrived at, and whether the revenue for street lighting was included. In the calculation of these figures the total revenue per annum for private lighting, public lighting and traction supply was taken and divided by the population of the area of supply. The revenue from meters and other sources was omitted, since many extraneous items, such as sale of land, rental of house property, &c., were included. This method of comparing the commercial activity of any one town with another is, of course, only an approximate one, but at the same time it is one that clearly indicates the possibilities of further commercial development in any particular town. Considering the town of Chelmsford as an example as requested by the querist, and taking the population as 12,600 and the total revenue per annum for private lighting and motors as £7,961, the income per head of population will be 12s. 7·6d., an exceptionally good figure, for it must be noted that there is no public electric lighting or tramway load. It may be asked whether this figure should not be corrected by making an allowance for the lack of these additional loads, as, of course, the figure of 12s. 7·6d. for a private lighting load alone is a very high one, and would put the station in a much better position in comparison with the private lighting loads of other stations. However, for general purposes of comparison it does not seem advisable, since a station cannot be said to have obtained all the business available until it has secured the public lighting load. Undoubtedly, public lighting by electricity will be more and more demanded in the near future, since the need of much better street lighting is beginning to be appreciated, and gas lighting seems to have about reached its limits for that purpose.

It is, therefore, a part of the business of a supply authority to educate the public it serves up to this point, so as to bring about the desired consummation of a public lighting load at an earlier date than if matters were to follow their natural course.

(To be continued.)



No. _____ Street _____ District No. _____

Name _____

Business _____

Source of Inquiry _____

Interested in _____

Now using _____

Is building wired? _____

Literature sent _____

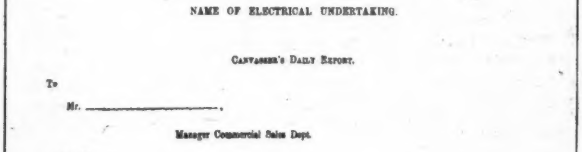
FRONT OF CARD.

CALLS MADE.

Name of Canvasser.	Date.	Remarks.

BACK OF CARD.

A Form of Index Card for Prospective Customers.



NAME OF ELECTRICAL UNDERTAKING.

Canvasser's Daily Report.

To

Mr. _____,

Manager Commercial Sales Dept.

Dear Sir—

I have to report that I called on the following parties to-day with the results indicated :—

Forenoon.

Name.	No.	Street.	Time.	Remarks.

Afternoon.

District No. _____ Yours faithfully,

Canvasser.

Form for Canvasser's Daily Report.

LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names may be made. Answers are furnished by a barrister-at-law.*]

No. 71.—Aerial Lines—Supply at 200 volts, where Declared Pressure is 100.

"L. S. D." writes:—"An hotel keeper requires electric light for an hotel situate in an isolated field, through which a H.T. cable passes; for this purpose it is proposed to erect an aerial line 500 yards long, for which consumer pays supply company cost of erection. No telegraphic lines, railways, roadways, or other houses near aerial line.

"Please state (1) whether the company may supply consumer at 200 volts, whilst declared pressure in provisional order is 100 volts? (2) Is consent of B. of T. necessary for erection of such aerial cable? (3) The consumer's meter being fixed in transformer house in same field, does liability of supply company cease at meter, or are they responsible for accidents or damage that are caused by the aerial cable?"

*** With regard to (1), while the Electric Lighting Acts and the Board of Trade regulations appear to contemplate that the standard pressure of supply shall be fixed by the undertakers before commencing a supply in their district, there is little doubt that in a particular case supply at 200 volts would be permissible.

As to (2), it is provided by Sec. 10 (*b*) of the schedule to the Electric Lighting (Clauses) Act, 1899, that the undertakers shall not, without the express consent of the Board of Trade and, where the local authority are not themselves the undertakers, of the local authority also, place any electric line above ground, except within premises in the sole occupation or control of the undertakers, and except so much of any service line as is necessarily so placed for the purpose of supply. The Board has issued regulations as to aerial lines, with none of which "L. S. D." should have any difficulty in complying. These regulations may be obtained from Messrs. Eyre & Spottiswoode. They are also set out in Shiress Wills's "Law of Electric Lighting," third edition, page 247.

As to (3), Sec. (36) of the regulations referred to in the answer (2), *supra*, provides that the undertakers shall be responsible for all electric lines, fittings and apparatus belonging to them or under their control, which may be upon a consumer's premises, being maintained in a safe condition, and in all respects for supplying energy. In the light of this regulation, it would appear that the company would be liable for any damage caused by the fall of the cable if insecurely fixed.

No. 72.—Supply Company—Area of Supply—Supply outside Area.

"Nemo" writes:—"A company working under provisional order has at various times received applications from persons or firms whose property is partly within, and partly outside, the said company's area, and in the cases under consideration, the parts outside the company's area are not in any other supplier's district. If the company's service mains, meters, &c., are wholly within the area, and the whole of the distribution system which is outside the company's area is the property of the consumer, can a supply be given without contravening the provisions of Sec. 6 of the provisional

order, which prohibits supply by the undertakers outside their prescribed area?

"The power would be used partly within and partly outside the area, but supply would be given entirely within the area."

*** This question has been frequently dealt with in this column. It is clear, upon the authority of the Gas Light and Coke Co. *v.* South Metropolitan Gas Co., 62 L.T. 126, that electricity generated within, may not be used without, the company's district. The fact that the parts outside the area are not in any other supplier's district does not affect the question.

No. 73.—Local Authority and Consumer—Cost of Connecting up—Liability of Consumer.

"Onlooker" writes:—"We have recently carried out a small installation (some 15 lamps) in small business premises. The local supply authority, who usually make a charge for laying in the service and main connection, refuse to connect up the installation, because our client will not pay a matter of £2 10s. for this work; he claims that he has had service free in other towns. He is very firm on the point, and has been legally advised that he can sue the lighting authority in the County Court for £2 per day; as the matter has been standing some three weeks, this is mounting up. The authority are working under an ordinary provisional order granted some four years ago; the mains are laid past the consumer's premises, about 40 ft. away across the public street; 2 ft. of cable through private wall only is required. Is he likely to succeed in such a claim?"

*** To understand the nature of the charge of £2 10s. which it is sought to impose in this case, it would be necessary to see the provisional order, and the terms of the contract entered into between the consumer and the local authority. Moreover, the statement of facts does not make it clear whether the sum in question is a deposit or not. Presumably these matters were considered by the consumer's legal adviser. It would be unsafe for anyone to advise proceedings without access to the documents mentioned above, which the consumer's solicitor must have had before him. It may be mentioned that there does not seem to be anything in the Electric Lighting Acts which entitles the local authority, in the absence of an agreement to that effect, to charge the consumer with the cost of connecting up.

SEPARATE GENERATING STATIONS.

The youngest student of the I.E.E. is, perhaps, the scientific equivalent of the "every school boy" of Macaulay's essay. He would, we feel sure, have answered a question propounded by Mr. Norman Carty in a recent issue of the *Western Electrician*, in a very different, and far saner manner than does the latter. Given an inter-urban railroad 50 miles in length, with five 50-ton cars, running at 30 miles an hour on one hour headway, for 18 hours a day, average kilowatts per car 100, or 70 watts per ton-mile [What are watts per ton-mile?—Eds.], the instructors of the said youngest student would have been appalled if he did not, in the first place, demur to such an attenuated load being considered from the electrical standpoint unless coal was out of the question. Under such circumstances, the youngest student would suggest a single-power station situated at the middle of the line, with a single phase high-tension overhead wire, and step-down transformers with low-tension single-phase motors on the cars. If, however, he were convinced, as we assume Mr. Carty is, that "it does not require any argument to convince the operator of electric-railway properties of the greater simplicity and reliability of the direct-current system as compared with any method of alternating-current transmission," he would concede direct current for the cars, and put down a couple of converter sub-stations, each situated about 16½ miles on either side of the alternating-current generating station, thus dividing the line into three sections, one at each end supplied from sub-stations, and the central section supplied from converters in the power house. That is not Mr. Carty's solution, which would provide four separate sub-stations, each containing a 150-kw. 650-volt direct-current generating set, driven by a Diesel engine and a 240 ampere-hour storage battery. Giving the battery a normal discharge rate of 60 amperes per hour, we thus have each station capable of supplying, with the engine at full load, about 190 kw.

Taking the author's figures at 70 watts per ton per car-mile [?], and assuming that the cars travelled at the maximum speed of 30 miles per hour, the actual load per station, with cars running at one hour's headway, would be 87·5 kw., or for the entire line 350 kw. The author assumes "the installation of the storage battery in connection with the Diesel engine would eliminate any necessity for reserve generating apparatus, as the combined capacity of the generating equipment and storage reserves in each station would be equal to the demand for intervals long enough to meet the extreme operating conditions for peak loads." He then proceeds to assure his readers that if one main steam-driven station were put down, the equipment would comprise two steam-driven sets of 600 kw. each (one in reserve), and each of the four sub-stations would require two 300-kw. rotary converters (one, of course, in reserve). Upon these premises some surprising balance-sheets are submitted, and it is claimed that the initial cost of the steam-driven alternative would be $225,000 as against $140,000 for the multiplicity of isolated generating stations.

Lack of space must prevent our detailed examination of Mr. Carty's figures, and comparisons which include the statement that "the expense of maintaining the high-tension line and transformer stations would greatly exceed the expense of maintaining the storage batteries connected with the Diesel system." His operating staff is sparse, and he suggests one chief engineer as general supervisor, and eight assistants (one of whom is to run single-handed each generating station during a 9-hour shift). His fuel costs reckon oil at 3 cents per gallon, and 12½ gallons of oil per 100 kw.-hours. This exactitude may be contrasted with the assertion that "no one will guarantee the fuel consumption of a steam plant."

With advocacy of this character, the Diesel engine is best delivered from its friends. Granted that its fuel consumption is really very low indeed, and granted that the cost of repairs is less than that of steam engines of equal capacity (although many engineers could be found holding a contrary view), there is no reason why it should be dragged in, like King Charles's head, in season and out of season, by injudicious advocates.

International Prize Competitions.—The Association of Italian Manufacturers offers a Gold Medal and 8,000 lire for a system to eliminate the danger of a contact (of whatever resistance) between the primary and secondary circuits of alternating current transformers and their respective lines. A Gold Medal and 1,000 lire are also offered for a hand crane or winch so constructed that without sensibly reducing the efficiency or speed of lowering as compared to ordinary types, any danger due to the rotation of the handles by the descending load is avoided. Particulars can be had from the Director of the Association, 61, Foro Bonaparte, Milan. This competition was announced also in our issue of March 24th, 1905.

Rating of Machinery.—The London and Provincial Machinery League writes to call the attention of our readers to the unfair handicapping of British industry by the rating of machinery not belonging to the hereditaments, which the League was formed to remedy. Such machinery is not rated in Scotland, nor abroad, nor is the practice in the various boroughs throughout England at all uniform. The League has framed a Bill which aims at preventing further inequalities and anomalies in the rating practice of various boroughs; it also tends to place England and Scotland on an equality. The question is a vital one to all who have our industrial supremacy at heart, to all employers and employed, and to ratepayers in districts which manufacturers are deserting for other places where, for the moment, machinery is not rated. Manufacturers and all in sympathy with the objects of the League are invited to join forces with it, and Mr. R. M. Leonard, secretary, of 30, Oxford Court, E.C., will be glad to furnish readers with further information.

The Metric System.—The secretary of the Decimal Association, Mr. E. Johnson, sends us a batch of opinions in favour of the adoption of metric weights and measures, and a list of donations to the Special Effort Fund. It is intended to introduce a Bill in the next session of Parliament, and help is invited.

We note that a curious fact is mentioned by Lord Belhaven; for many purposes an error of 1 per cent. is negligible, and if we take 25·6 mm. to represent 1 in., instead of 25·4, an error of less than the above, we have the binary divisions of the inch represented by equally simple values in millimetres:—

Inch	1	½	¼	⅛	1/16	1/32	1/64	1/128	1/256
Millimetres ...	25·6	12·8	6·4	3·2	1·6	·8	·4	·2	·1

This is a convenient memory rule.

In view of the forthcoming Colonial Conference, at which the Colonial representatives will be able to state that their respective Governments are definitely committed to the early adoption of the metric system, every effort should be made to educate public opinion in this country so as to ensure that the deepest possible impression may be made by the announcement.

We have received a simple set of "Anglo-Metric Tables" from Mr. P. E. Radley, 30, Theobald's Road, W.C., giving metric weights and measures, with English equivalents, and *vice versa*, together with ready reckoners for both systems.

A Vibration Case.—The case of the Demerara Electric Co., Ltd., *v.* Frederick White and others came before the Judicial Committee of the Privy Council on January 31st, on an appeal from the Supreme Court of British Guiana. It was an appeal by the Demerara Electric Co. in an action brought by the owners and occupiers of certain houses near the appellants' power station at Georgetown, in which the plaintiffs sought to recover damages and an injunction on account of vibration. By the Georgetown Electric Lighting Order, 1899, the appellants were granted the exclusive right of supplying electric energy for all public and private purposes and using the same for any undertaking lawfully carried on by them within the area of supply, which included Georgetown. The case was heard by three judges, who came to the conclusion that the evidence showed that the effects of the vibration were such as to affect the comfortable enjoyment of the plaintiffs' houses, and they accordingly granted an injunction, with small damages and costs. The appellants now asked that the judgment of the Colonial Court might be set aside. Their Lordships reserved judgment.

NEW PATENTS APPLIED FOR, 1907.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

23,077A/05. "Improvements in process of electric welding." L. S. Lachman. (Date applied for under Rule 5 of the Patents Rules 1905, October 8th, 1906. Renumbered from 25,152/06, which number is cancelled.) February 5th. (Complete.)

2,712. "Improvements relating to telephone receivers." A. P. Mullins. February 4th.

2,720. "Improvements in or relating to the lighting by electricity of miners' safety lamps in coal mines and other places." W. Patterson. February 4th.

2,748. "Improvements in electric couplings for railway signals." Siemens Bros. & Co., Ltd., and L. M. G. Ferreira. February 4th. (Complete.)

2,750. "Improvements in or relating to motor starting switches." T. von Zweigbergk. (Date applied for under Patents Act, 1901, May 21st, 1906, being date of application in United States.) February 4th. (Complete.)

2,752. "Improvements in or relating to controllers for hoisting or elevator motors." T. von Zweigbergk. (Date applied for under Patents Act, 1901, November 28th, 1906, being date of application in United States.) February 4th. (Complete.)

2,803. "Improvements in rheostats." T. Reishoff. February 4th. (Complete.)

2,815. "Safety terminals for electric accumulators and other appliances for use in mines or otherwise." J. C. Best. February 5th.

2,822. "Improvements in coil friction clutches." G. Sherriff. February 5th.

2,830. "Improvements in connection with mercury-vapour electric lamps." C. J. Hall. February 5th.

2,842. "Improvements in apparatus for producing an intermittent electric current." E. D. Rodway. February 5th.

2,869. "Improvements in fire-alarm apparatus." J. T. Marriott. February 5th. (Complete.)

2,877. "Improvements in galvanic cells." K. Ruter. (Date applied for under Patents Act, 1901, February 6th, 1906, being date of application in Germany.) February 5th. (Complete.)

2,888. "Improvements in or relating to the starting and controlling of electric induction-motors." J. Schuil. February 5th.

2,889. "Improved automatic electric switch." A. Schappi. (Date applied for under Patents Act, 1901, February 5th, 1906, being date of application in Switzerland.) February 5th. (Complete.)

2,921. "Improved self-binding insulator." J. R. Turton. February 6th.

2,926. "Improvements in and relating to indicating and recording apparatus for electric pyrometers and the like." W. Armour. February 6th.

2,928. "Improvements in lifting apparatus for armatures of electric motors." R. L. Acland and Brecknell, Munro & Rogers, Ltd. February 6th.

2,930. "Improvements in mechanism for reverse current circuit-breakers." J. Sugden and E. D. Rodway. February 6th.

2,936. "Improved construction of electricity recording time meter." T. E. R. Phillips. February 6th.

2,937. "Improvements in the apparatus for making and breaking the current on electrically-fired internal explosion engines and the like." J. H. Chambers and P. F. B. Bennett. February 6th.

2,938. "Improvements in means for attaching stair rods, electric wires, gas pipes, pictures and the like to angular and plain surfaces." L. T. Bench. February 6th.

2,959. "Improvements in and connected with electrical insulators for telegraph or telephone wires or the like." T. F. Purves and J. Sinnott. February 6th.

2,963. "Improvements relating to electric arc lamps." J. M. Wellington and W. F. Daniell. February 6th.

2,964. "Improvements relating to electric arc lamps." J. M. Wellington and W. F. Daniell. February 6th.

2,973. "Improved method and means for actuating electro-mechanical fog signals for railways." G. Lowthian. February 6th.

2,983. "Improvements relating to automatic electrical targets for rifle practice." S. A. M. Rose. February 6th. (Complete.)

2,986. "Improvements relating to electrical apparatus for transmitting and receiving signals." A. T. Dawson and G. T. Buckham. February 6th.

3,000. "Improvements in or relating to electrolytic apparatus." A. J. Boult. (Elektrizitats Akt. Ges. vormals Schuckert & Co., Germany.) February 6th. (Complete.)

3,001. "Improvements in or relating to type-printing telegraphs." L. Cerebotani and A. Silbermann. February 6th. (Complete.)

3,008. "Improvements in and connected with guards or fenders for electric tramcars." K. Lhotta, T. Lhotta and E. Lhotta. February 6th. (Complete.)

3,025. "Improvements in electric cut-outs." V. Hope. February 7th.

3,026. "Improvements in combined electric switches and cut-outs." V. Hope. February 7th.

3,029. "New or improved device for simultaneously bolting doors and switching on electric lights." A. E. Wynn. February 7th.

3,060. "Improvements in electric arc lamps." A. D. Jones. February 7th.

3,063. "Improvements in coal-tar pitch as a binding and waterproofing material for asphalt pavements or roads and as a material for damp courses, electric installation trenches, waterproofing and for purposes for which imported natural bitumen is at present used." T. Marriott. February 7th.

3,067. "Improvements in printing telegraphs." J. D. White. February 7th.

3,078. "Electric steam radiator." C. G. Nobbs and C. G. Nobbs, jun. February 7th.

3,082. "Improvements in apparatus for electrically detecting railway points or the like." Siemens Bros. & Co., Ltd. and L. M. G. Ferreira. February 7th. (Complete.)

3,089. "Improved apparatus for preventing overcharging of accumulators and for automatically establishing and breaking the charging circuit from a dynamo specially applicable for train lighting." F. J. Beaumont. February 7th.

3,116. "Improvements in and connected with electric heaters." J. G. S. Cunnington. February 7th. (Complete.)

3,124. "Arrangement to utilise the electric and motive energy contained in permanent magnetism." W. G. Shipwright. February 8th.

3,128. "New or improved electric dynamo." E. Turner. February 8th.

3,141. "Improved automatic cut-off for overhead electric trolley wires." W. Lowson. February 8th.

3,158. "Improvements in relays." E. R. Clarke. February 8th.

3,180. "Improvements in or relating to alternating-current rectifiers." E. F. Everett. February 8th.

3,184. "Improvements in the method of and apparatus for treating textile fibres or materials by electrolysis in cleansing, extracting, carbonising, stripping, sterilising and disinfecting same." F. Spivey. February 8th.

3,189. "Improvements relating to the supports and connections of electric conductors and cables." N. Astafieff. February 8th.

3,190. "Improvements relating to electrically-driven hoisting apparatus." E. F. Long.

3,214. "Improvements in counting trains for electricity meters and the like." G. Hookham. February 8th.

3,215. "New or improved method of effecting Hertzian telephony and apparatus therefor." E. Rummer. February 8th.

3,226. "Improvements in electric lamp heating apparatus." A. B. Holmes. February 9th.

3,245. "Improvements in arc lamps." T. L. Carbone. (Date applied for under Patents Act, 1901, March 17th, 1906, being date of application in Germany.) February 9th. (Complete.)

3,247. "Electrical contact device for the ignition of explosive charges." F. Fink. February 9th. (Complete.)

3,254. "Improvements relating to time switches for electric circuits, and more particularly for use with electric lights." R. F. Venner and R. C. Griesbach. February 9th.

3,276. "Improvements in the crowns or covers of electric furnaces." R. B. Ransford. (La Soc. Anon. Electro-metallurgique Paul Girod.) February 9th. (Complete.)

3,305. "Improvements in and relating to electrical brakes for hoisting apparatus, cranes and the like." W. Reuter. February 9th. (Complete.)

3,306. "Telegraph." H. Knudsen. February 9th.

3,308. "Improvements in the electrical process of refining metal." C. A. Keller. February 9th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1905.

Position, Fare and Distance Indicator and Timekeeper for Public Conveyances and the like. C. Bright. 22,897B. November 8th. (Date applied for under Rule 5, Patents Rules 1905, June 8th, 1906.)

1906.

Electrical Junction and like Boxes. C. C. Sibley and G. A. Lutz. 10,654. May 7th.

Electro-Magnetic Clutches. W. Schuster and H. Ast. 13,066. June 6th.

Electro-Magnetic Clutches. W. Schuster and A. Ast. 13,067. June 6th.

Method for the Prevention of Sparking in Current Interrupters and the Like. F. Schneider. 13,373. June 11th.

Apparatus for Automatically Regulating the Currents of Electric Circuits. Siemens Bros.' Dynamo Works, Ltd. (Siemens Schuckertwerke.) 15,033. July 2nd.

Apparatus for Automatically Regulating several Parallel-connected Electrical Generators. Siemens Bros.' Dynamo Works, Ltd. (Siemens Schuckertwerke.) 15,035. July 2nd.

Automatic Electric Fire Alarm. W. G. Meddings. 16,896. July 20th. (Date applied for under International Convention, October 10th, 1905.)

Electric Fuses or Cut-outs. W. Menzel. 17,213. July 31st.

Electric Controllers. F. Volk. 18,227. August 14th. (Date applied for under International Convention, September 12th, 1905.)

Apparatus for Altering the Self-Induction in Alternating-Current Circuits. J. W. Mackenzie. (Firm of C. Lorenz.) 20,472. September 14th.

Moulds for Casting Anode Plates. R. Truswell. 22,314. October 9th. (Date applied for under International Convention, October 9th, 1905.)

Electrical Ignition Devices for Explosion Engines. H. C. Brasier. 23,898. October 26th. (Date applied for under International Convention, October 28th, 1905.)

Dynamo and Magneto-Electric Current Generators for Therapeutic Purposes. G. E. Gaiffe. 890. January 12th.

Filaments for Incandescent Electric Lamps. British Thomson-Houston Co. (General Electric Co.) 929. January 12th.

Apparatus for Producing Electricity. J. De Törley and E. Benkö. 988. January 13th.

Battery Testing Apparatus in Pocket Size. H. Oppenheimer. (Akt.-Ges. Mix & Genest.) 1,151. January 16th.

System of Automatically Indicating and Recording Movements of Trains and Tramcars. H. H. Lake. (Steiner Investment Co.) 1,198. January 16th.

Automatic Signalling Systems for Use in Connection with Trains and Tramcars. H. H. Lake. (Steiner Investment Co.) 1,207. January 16th.

Indication, Measuring and Recording of Electric Currents. R. Arno. 1,221. January 16th. (Date applied for under International Convention, January 17th, 1905.)

Electrical Switch for Increasing or Decreasing the Number of Lamps or other Appliances in Use. C. J. Turner. 1,259. January 17th.

Electric Arc Lamps. British Thomson-Houston Co. and E. J. Murphy. 1,308. January 17th.

Secondary Batteries. A. P. Strohmenger. 1,396. January 18th.

Signalling Apparatus for Railways and other Purposes. G. Hughes. 1,589. January 22nd.

Dynamo-Electric Machines. S. Von Ammon. 1,691. January 23rd.

Electricity Meters. W. M. Mordey and G. C. Fricker. 1,963. January 25th.

Electric Controllers. British Thomson-Houston Co. (General Electric Co.) 2,065. January 26th.

Dynamo-Electric Machines and Electric Motors for Maintaining a Constant Electromotive Force under Variations of Speed. M. W. W. Mackie. 2,364. January 30th.

Construction of Electro-Magnets. H. Lacy. 2,887. February 6th.

Prepayment Mechanism Especially Applicable for Use in Connection with Electric Meters. British Thomson-Houston Co. (General Electric Co.) 3,243. February 9th.

Vapour Lamps. W. Hartley. 4,014. February 19th.

Engine Room Telegraphs and the like. J. H. Collie. 4,449. February 23rd.

Devices for Electrically Controlling and Operating the Track Points of Electric Railways and Tramways. J. P. Opsahl. 4,518. February 24th.

Electric Fuse Carriers. C. Beckingsale and Reason Manufacturing Co. 4,850. February 27th.

Alternating-Current Dynamo-Electric Machines. British Thomson-Houston Co. (General Electric Co.) 6,195. March 14th.

Manufacture of Metallic Filaments for Electric Incandescent Lamps. A. G. Bloxam. (J. Lux.) 7,189. March 24th.

Apparatus for Suspending or Supporting Arc Lamps and like Articles. Crompton & Co. and A. E. Spencer. 7,587. March 29th.

Electric Sterilising Apparatus. A. Douilhet. 8,382. April 6th. (Date applied for under International Convention, April 10th, 1905.)

Devices for Supporting the Line Wires of Electric Railways or Tramways. C. De Kando. 9,341. April 20th.

Leading-in Wires for Electric Incandescent Lamps. S. O. Cowper-Coles. 10,625. May 1st.